Engineering Library

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With BRITISH INDUSTRIES FAIR SUPPLEMENTS.

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VOL. CXLIX.—No. 3867] LONDON: FRIDAY EVENING, FEBRUARY 21, 1930 [PRICE {WITH SUPPLEMENTS} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for :—

SCHEDULE 1.—WHEELS and AXLES, 5ft. 6in. gauge; Pairs, 1112.
AXLES, 5ft. 6in. gauge; number, 1098.
WHEELS and AXLES, metre gauge; Pairs, 2122.
WHEELS, with TYRES ONLY, metre gauge; number, 644.

SCHEDULE 2. — FORTY-FOUR LOCOMOTIVE BOILERS, 2-8-0 Type.

Tenders due as follows :—
Schedule 1, 14th March, 1930.
Schedule 2, 25th March, 1930.

Forms of Tender available from the above at a fee (which will not be returned) of 5s. for each Schedule. 4496

Crown Agents for the COLONIES.
COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POSTS :—

M/1740.—ASSISTANT HARBOUR ENGINEER REQUIRED by the GOVERNMENT of the GOLD COAST for the Takoradi Harbour, for a tour of 12 to 18 months' service. Salary £600 a year, rising to £720 by annual increments of £30 and thence to £920 a year by annual increments of £40. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, age 25 to 35, must have passed "A" and "B" of the examinations to qualify for the A.M.I.C.E. Diploma or hold professional qualifications recognised by the Institution of Civil Engineers as exempting from those examinations. Should have had some civil engineering experience outside pupilage, preferably on Harbour and Dock Works.

M/1650. — ASSISTANT DRAUGHTSMAN REQUIRED by the GOVERNMENT of NIGERIA for the Survey Department for two tours of 12 to 18 months' service and possible extension. Salary £495, rising to £600 a year by annual increments of £15. Free quarters and passages and outfit allowance of £60 on first appointment. Liberal leave on full salary. Candidates, aged 25 to 35, must be skilled survey draughtsmen and have had a thorough training in the various draughting processes required in a large survey drawing-office and have some knowledge of the type of work for lithographic reproduction. Experience is required in the drawing and preparation of Cadastral Plans and Topographic Field Sheets for reproduction. Some knowledge of the principles and methods of surveying is required and an ability to take complete charge of a large staff of African draughtsmen during absence on leave of the Chief Draughtsman.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W.1, quoting the reference number against the appointment for which application is made. 4492

Factory Premises (KINGSWAY ENGINEERING WORKS), Clapington-road, Dundee, by PRIVATE TREATY; main block (built, 1925) consists of extensive Machine Hall, Administrative Offices, &c., Centrally heated, electric light, power and gas installations; also other Factory Type Buildings, Stores, &c. Could be adapted for use as garage and workshop. Site area about 5 acres. May be inspected on application to the Caretaker on the premises.—Further particulars from DIRECTOR OF LANDS AND ACCOMMODATION, H.M. Office of Works, King Charles-street, London, S.W.1; or H.M. OFFICE OF WORKS, 122, George-street, Edinburgh. 4470

University of Birmingham.
APPOINTMENT OF ASSISTANT LECTURER IN DEPARTMENT OF METALLURGY.

APPLICATIONS are INVITED for the POST of ASSISTANT LECTURER in METALLURGY. Preference will be given to candidates with practical experience in the Metallurgy of Steel. Stipend £300 per annum. Duties to begin not later than 29th April, 1930. Four copies of application, with testimonials or references, must be sent on or before 3rd March to the undersigned, from whom further particulars may be obtained.

C. G. BURTON,
Secretary.

The University,
Edmund-street, Birmingham,
February, 1930. 4451

The Bengal and North-Western RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

TWO BOILERS and DUPLICATE PARTS for LOCOMOTIVES,

as per specification to be seen at the Company's offices.

Tenders, addressed to the undersigned and marked "Tender for Boilers, &c.," with name of firm tendering, to be lodged not later than Noon on the 11th day of March, 1930.

For each specification a fee of 10s. will be charged, which cannot under any circumstances be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
W. R. IZAT,
Managing Director.

237, Gresham House,
Old Broad-street, London, E.C. 2.
18/2/1930. 4477

The Portsmouth Gas Company invite APPLICATIONS for the POSITION of ASSISTANT ENGINEER.

Commencing salary £700 per annum.

Applicants must have had a sound engineering training and be fully experienced with the design and construction of all plant required by the Company's operations from Coal Unloading Docks to the Gasholders. A knowledge of distribution, including the design of plant necessary for the supply of gas to outlying districts is also essential.

The successful candidate will participate in the contributory superannuation benefit and will be required to pass a medical examination.

Applications, giving age, full particulars of training and experience, should be accompanied with two recent testimonials and received by the Chairman of the Company, in an envelope endorsed "Assistant Engineer," not later than 27th February instant.

T. CARMICHAEL,
Engineer.

The Portsmouth Gas Company,
Chief Offices, The Square, Portsmouth. 4422

The Engineer

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TWO GENERATING SETS FOR SALE.

ONE BELLISS and MORCOM TOTALLY ENCLOSED STEAM ENGINE, triple-expansion, cross type, self-lubricating, 2200 H.P., 200 r.p.m., 165 lb. steam pressure

Direct coupled with

ONE THREE-PHASE GENERATOR, 1400 kW, 50 cycles, 5000/5500 volts, 206 amps., with exciter, surface condenser, air pump and circulating water pump.

This unit has been completely overhauled and is in perfect working order.

ONE PARSONS STEAM TURBINE (Richardsons, Westgarth and Co.), 2200 H.P., 1500 r.p.m., 165 lb. steam pressure.

Direct coupled with

ONE THREE-PHASE GENERATOR, 1500 kW, 50 cycles, 5000/5500 volts, 157/216 amps, with exciter, with condenser contraflow pattern, air pump and circulating water pump.

This unit is in excellent condition.

Further particulars may be obtained from the SECRETARY,

The Irish Free State Electricity Supply Board,
Upper Mount-street, Dublin 4439

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

ENGINEERING ASSISTANT REQUIRED in the Research Department of a large English Engineering Firm. Candidates should be graduates in physics or engineering, and some works experience is desirable. The work would be of a general character, but a knowledge of the fundamentals of heat transmission and fluid motion would be an advantage, and applicants should refer to their experience in these matters.—Address full particulars of qualifications, training and experience, with copies of recent testimonials 4473, The Engineer Office. 4473 A

PUBLIC NOTICES

Madras Port Trust.
APPOINTMENT OF EXECUTIVE ENGINEER TO THE PORT OF MADRAS.

APPLICATIONS, in writing, for the above APPOINTMENT will be received by the undersigned on behalf of the Trustees of the Port of Madras up to 14th March, 1930.

Candidates must hold the B.Sc. Degree in Engineering of a recognised University or be an Associate Member of the Institution of Civil Engineers by examination, and must have previous practical experience on Dock and Harbour Works, and preferably a knowledge of Reinforced Concrete Design and Construction.

SALARY.—Rupees 1250 per mensem, rising by annual increments of Rs. 50 to Rs. 1650 per mensem, with free quarters or Rs. 150 per mensem house rent allowance.

TERMS.—Candidates must be of robust physique, and before appointment the applicant selected will be required to pass a strict medical examination by a medical officer nominated by the undersigned on behalf of the Trustees. He will also be required to enter into an agreement for a period of three or five years, and will be provided with free first-class passage for himself to Madras, and return passage to England on termination of his agreement, subject to the conditions of his agreement.

Applicants should forward copies of testimonials (which will not be returned), also particulars of nationality, education, age, whether married or single (if married state number in family), diplomas or degrees, accompanied by a record in chronological order of candidates' training and subsequent experience.

RENDEL, PALMER & TRITTON,
55, Broadway, London, S.W. 1. 4487

SITUATIONS OPEN (continued)

THE BRUSH ELECTRICAL ENGINEERING CO., Ltd., of Loughborough, invites APPLICATIONS for the POSITION of WORKS SUPERINTENDENT of their Engineering Department. The manufacture embraces Steam Turbo-generators and Electrical Machinery of all types. Applicants must have had experience in similar capacity.—Letters, giving full particulars of career and salary required (which will be treated confidentially), should be addressed to the SECRETARY of the Company, Falcon Works, Loughborough 4476 A

SITUATIONS OPEN (continued)

WANTED, a Skilled CENTRIFUGAL PUMP DESIGNER, having held responsible position and who thoroughly understands modern Centrifugal Pump practice. A good salary to really capable man. State age, experience and salary.—Address, 4498, The Engineer Office. 4498 A

WANTED by Leading Engineering Insurance Company, additional INSPECTORS, fully qualified in best Crane and Lift practice. Age 28 to 32. Commencing salary £260 per annum.—Address, with full particulars of experience, age, &c., 4469, The Engineer Office. 4469 A

WANTED, First-class MILLWRIGHT for Paper Mill, London district; stage age, full details of training and experience, and wages required. Only first-class men need apply.—Address, 4494, The Engineer Office. 4494 A

WANTED, London District, First-class ENGINEER, with expert knowledge of Drop Valve Steam Engines and B. & W. Boilers, and capable of carrying out all adjustments and running repairs. State age, full details of training and experience, and wages required. Only first-class men need apply.—Address, 4493, The Engineer Office. 4493 A

A FIRM of ELECTRICAL ENGINEERS REQUIRE PART-TIME REPRESENTATIVES in every area in Great Britain, of sound connection with leading Constructional and General Engineers, Tool makers, Shipyards, Railway Companies, Garages, &c., for the sale on a generous commission basis of small specially designed Electrical Tools especially applicable for steel work and woodworking. Highest class manufacture and attractive prices.—Write fullest particulars, with present obligations and lines, in strictest confidence, to "T. E.," c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, London, E.C. 2. 4491 A

DIESEL ENGINEER.—CHIEF ENGINEER of Aero-engine Factory, experimenting on compression ignition aircraft engine, REQUIRES ASSISTANT to Take Charge of this Section; must have had experience, keen and energetic, and capable of taking responsibility.—Address, stating age, experience, and salary required, 4467, The Engineer Office. 4467 A

GENERAL MANAGER, ENGINEERING WORKS, —CHIEF ENGINEER of large Engineering Works manufacturing very high-class Precision Product REQUIRES ASSISTANT to act as General Manager of the production side of the factory. Must have had previous engineering executive experience and good organising ability. Excellent opportunity for first-class man.—Address, stating age, experience, and salary required, 4466, The Engineer Office. 4466 A

REQUIRED for Important British-owned Railway in Argentina, CIVIL ENGINEER to fill a senior post. First-class railway experience essential, and must be energetic and possess first-class references. Must also be Member Inst. C.E. and not more than 45 years of age. Knowledge of Spanish advantageous. —Reply, sending copies (only) of testimonials, with full details of education, training and experience, to Box W.P.A., c/o Davies and Co., 95, Bishopsgate, London, E.C. 2. 4479 A

STEEL WORK DESIGNER REQUIRED in London by Firm of Structural Engineers. Applicants must have had experience in designing schemes for Steel-framed Buildings and Theatres, also knowledge of L.C.C. requirements. Full particulars in confidence.—Address, 4485, The Engineer Office. 4485 A

WORKS and GENERAL ENGINEER REQUIRED for large factory. Knowledge of Chemical Works an advantage. Must be good organiser and disciplinarian. Only applications showing experience in a similar position will be considered. State age. Advertisers are prepared to pay good salary.—Address, P6702, The Engineer Office. P6702 A

WANTED, Young MECHANICAL DRAUGHTSMAN for Engineering Works in Midlands. Some knowledge of modern Building Construction an advantage. Please write, stating details of experience, age, and wages required.—Address, 4462, The Engineer Office. 4462 A

CHIEF DRAUGHTSMAN WANTED; 15/20 Draughtsmen; Tanks, Pressure Vessels and General Engineering. Must have had Workshop experience. Previous experience of Tank Work not essential. First-class practical knowledge of Design in Structural Work and general Mechanical Engineering essential. State age, experience and salary required.—ROBERT JENKINS and CO., Ltd., Rotherham. 4436 A

DRAUGHTSMAN, Experienced, for Quarry and Contractors' Machinery. State age, wage, and experience.—Address, 4459, The Engineer Office. 4459 A

DRAUGHTSMAN REQUIRED for Engineering Works in the Midlands. State age, experience, and salary required. Preference given to man with knowledge of Vehicle Construction.—Address, 4429, The Engineer Office. 4429 A

DRAUGHTSMEN, SENIOR, Having Sound Experience of Electric Control and Contactor Gear.—Applications, stating age, experience and salary required, with copies of references, 4415, The Engineer Office. 4415 A

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DRAUGHTSMAN WANTED by Manufacturing Engineers (precision work) in Luton, for Jigs, Fixtures and Small Tool Work; age about 24.—Address, giving particulars of experience and salary required, 4460, The Engineer Office. 4460 A

DRAUGHTSMAN WANTED, One having Experience in the Design of Portable Air Compressors. State age, full details of experience and salary expected. Preference will be given to one who can commence work immediately.—Address, 4499, The Engineer Office. 4499 A

EXPERIENCED DRAUGHTSMAN REQUIRED for temporary position in connection with the preparation of plans and estimates for Widening of Railways, Improvements of Goods Yards, &c.—Apply by letter to W. E. THORNHILL, Divisional Engineer's Office, L.M. and S. Rly., Crewe, stating age, experience, and salary required. 4474 A

EXPERIENCED GENERAL DRAUGHTSMAN REQUIRED for temporary position, accustomed to Surveying, Levelling, Preparing Plans and Estimates for Permanent Way, &c.—Apply by letter to W. E. THORNHILL, Divisional Engineer's Office, L.M. and S. Rly., Crewe, stating age, experience, and salary required. 4475 A

JIG, TOOL and PLANT DRAUGHTSMEN REQUIRED by large Motor Car Firm in Midlands. Men with experience of Production Methods and Layout of Motor Car Manufacture only need apply.—Address, 4461, The Engineer Office. 4461 A

JUNIOR DRAUGHTSMEN, 2 or 3, REQUIRED for general detailing work in connection with Steel Office Equipment, Bank and Library Fittings. Progressive posts for young men with energy and common sense, who are willing to learn a specialised branch of industry.—Address, stating age, salary required, and giving a brief outline of experience, 4465, The Engineer Office. Twelve miles from London, Essex. 4465 A

LONDON STRUCTURAL ENGINEERS REQUIRE DETAILING DRAUGHTSMEN. Previous experience in similar work essential. State age, salary required, and full particulars of experience. Permanent positions for suitable applicants.—Address, 4486, The Engineer Office. 4486 A

MACHINE SHOP FOREMAN WANTED for Large Engineering Works in Midlands; must have wide experience, and be thoroughly competent to deal with non-repetition work on a piecework basis; knowledge of Rate fixing an asset. Write, stating age, previous experience and salary required.—Address, 4502, The Engineer Office. 4502 A

REQUIRED, a SENIOR DRAUGHTSMAN for a South Wales Works; one with previous Rolling Mill experience preferred.—Address, stating age, experience, and salary required, 4500, The Engineer Office. 4500 A

WANTED, FOREMAN with Boiler Shop Experience, capable of handling all classes of riveted and welded Steel Vessels. Must be capable of estimating costs. District Leicestershire.—Address, P6709, The Engineer Office. P6709 A

SITUATIONS WANTED

ADVERTISER, Fully Trained Technical and Practical engineer, having large connection in the Midlands, DESIRES POSITION as Engineer Representative.—Address, P6677, The Engineer Office. P6677 B

AS TECHNICAL SALES REPRESENTATIVE.—ENGINEER (39), practical experience installation, running of chemical plant (20 types), DESIRES RESPONSIBLE POSITION; Lancashire district preferred.—Address, P6716, The Engineer Office. P6716 B

LEASE OF IMPOSING OFFICES FOR SALE.

In consequence of the recent amalgamation of "THE ENGINEER," Ltd., proprietors of "The Engineer," with MORGAN BROTHERS (PUBLISHERS) LTD., proprietors of "The Ironmonger" and "The Chemist & Druggist," the offices of the three journals will shortly be transferred to new and more commodious freehold premises which have been acquired at 28-31, Essex Street, Strand, W.C.2. The remaining 25 years of the long lease of the present offices of "The Engineer" at 33, Norfolk Street, Strand, W.C. 2, is in consequence for sale. The floor area of this important 5 storey office building is 8,200 sq. feet. This particularly well lighted building occupies a site at the corner of Norfolk and Howard Streets and is adjacent to the Temple Station, whence Westminster and the City may be reached in a few minutes. For further particulars apply to :—

WHATLEY, HILL & CO., 24, Ryder Street, St. James', S.W.1.

SITUATIONS WANTED (continued)

AN ENGINEER (31), B.Sc. Mech. Eng., DESIRES RESPONSIBLE APPOINTMENT.

Last 3 years surveyor to leading classification society, full-time apprenticeship, 4 years shops, 2 years drawing-office, 3 years' sea experience, B.O.T. certificate, good knowledge of French from residence in country. Business experience in Japan.

Address, P6698, The Engineer Office. P6698 B

CIVIL ENGINEER, British, M. Inst. E., M.I. Struct. E., M.R. San. I., &c., public school, foreign university education; over 25 years' experience large irrigation, sewerage, railways, roads, water and other works, Russia, Persia, Mesopotamia, India; seven years' executive position, Bombay Municipality; lately resident engineer with the Foundation Company, Ltd., of London, on their contract works, SEEKS RESPONSIBLE TECHNICAL or COMMERCIAL APPOINTMENT abroad. Good linguist, highest references.—Address, 4472, The Engineer Office. 4472 B

COST and WORKS ACCOUNTANT. Over 20 Years' experience in engineering trade, SEEKS RE-APPOINTMENT. Good organiser, accustomed to executive control.—Address, P6700, The Engineer Office. P6700 B

ENGINEER, A.M.I. Mech. E., Many Years' Experience design and manufacture process plant for chemical works, handling plant, factory layout and organisation, including male and female labour, problems in economical production, REQUIRES fresh APPOINTMENT in position of responsibility. Excellent references.—Address, P6689, The Engineer Office. P6689 B

MECH. ENGINEER (35), Shops and D.O. Experience, maintenance of factory plant, including auto, handling and packing m/cs., special knowledge of heat transmission as applied to cooking, drying, evaporating, &c., REQUIRES POSITION in charge of plant where above experience would be of value.—Address, P6715, The Engineer Office. P6715 B

DRAUGHTSMAN, Experienced in Comm. Vehicles, steam, petrol, low loading, 6-wheelers, trailers, tractors and equipment, DESIRES ENGAGEMENT.—Address, P6714, The Engineer Office. P6714 B

SITUATIONS WANTED (continued)

MECHANICAL ENGINEER, 7 Years Executive position at home and abroad, SEEKS POST, Chief Engineer or Assistant to Manager. Young, keen, ambitious, disciplinarian and worker. Really arduous and difficult position welcomed.—Address, P6711, The Engineer Office. P6711 B

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SECTION LEADER DRAUGHTSMAN (36) Will ORGANISE COMPETITIVE DESIGN and PRODUCTION; 6 years shops, 2 years sales and technical, 10 years centrifugal pumps and power plant.—Address, P6582, The Engineer Office. P6582 B

FOUNDRY FOREMAN (42) DESIRES CHANGE. Highly experienced loam, dry and green sand, plate and machine, general engineering and jobbing castings, controlling modern foundry; N.E. Coast; metallurgist. Highest refs.—Address, P6704, The Engineer Office. P6704 B

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For full particulars and advice apply to :—36, DALE-STREET, LIVERPOOL (Tel., Bank 1118). LONDON OFFICE : 65, CHANCERY-LANE, W.C. 2. Ex.

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PARTNERSHIPS.—Business Men in Need of further Working Capital and have no objection to a Private Limited Liability Company (sound propositions or patents entertained).—Write or 'phone Holborn 5048, RAY and RUSSELL, 88, Chancery-lane, London, W.C. 2. P6705 C

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The principals recently held appointments as chief mechanical and chief engineer of two well-known railways.

Address, P6699, The Engineer Office. P6699 B

ENTERPRISING FIRM of ENGINEERING AGENTS with offices in London and the provinces are PREPARED to OFFER FACILITIES to Industrial concerns for the DEVELOPMENT of BUSINESS in the London district and/or for provincial or overseas trade. Advertisers possess positive selling abilities, and the interests of principals would be fully represented.

Address, P6708, The Engineer Office. P6708 B

SOUTH AFRICA AND AUSTRALIA (Engineering Trade Agencies).—An English STEEL WORKS, with long experience in the mining industry and having established branches in these countries, is DESIROUS of UNDERTAKING the REPRESENTATION of One or Two High-class ENGINEERING PRODUCTS. Communications are invited in the first instance in strict confidence.—Address, 4464, The Engineer Office. 4464 D

For continuation of Small Advertisements see page 4.

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Modern High Grade MACHINE TOOLS

SEE OUR STOCK AT NORTH ACTON

A few selections from our large Stocks at North Acton:

	Price
Two 6A **Potter & Johnston** Automatics, serials 17466 and 17464, with quantity of equipment. Each	£215
Two 5A **Potter & Johnston** Automatics, serials 20488 and 20507, with quantity of equipment. Each	£175
Fay No. 1 Automatic.	£80
Libby 18in. Combination Turret Lathe. Rebuilt and guaranteed	£330
Cincinnati No. 2 Vertical Milling Machine, with circular table.	£340
Brown & Sharpe No. 1 Vertical Milling Machine.	£165
6½in. by 6ft. **Dean, Smith & Grace** Gap Bed, s.s. and s.c. Lathe, with Fixed and travelling steadies, 3 and 4 Jaw Chucks, etc.	£60
8½in. by 8ft. **Dean, Smith & Grace** Gap Bed Friction Geared s.s. and s.c. Lathe As new.	£220
Brown & Sharpe No. 3B Plain Milling Machine; Single Pulley Drive. Rebuilt and guaranteed.	£385
Brown & Sharpe No. 4B Plain Milling Machine; Single Pulley Drive. Rebuilt and guaranteed.	£495
Cincinnati No. 4 Plain Milling Machine, Single Pulley Drive. Rebuilt and guaranteed	£570
Brown & Sharpe No. 3 Universal Milling Machine; Cone Drive.	£235
Brown & Sharpe No. 3 Universal Grinder	£215
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Ask for our catalogue, which has just been reprinted, giving details of our stock of over 600 machine tools of every description.

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BIRMINGHAM SHOWROOM: 70, Lombard Street.

SEE OUR STOCK AT NORTH ACTON

A Seven-Day Journal

The British Industries Fair.

WE have already given an account of some of the exhibits at the Birmingham section of the British Industries Fair, and continue that account both in this issue and in our present Supplements. From these notes some idea of the general character of the Fair may be gained, and it will be appreciated that it is more extensive than any of its predecessors. The statistics as to its size have been so well broadcast by the daily Press that it is unnecessary to reiterate them; but there is one point which seems to have been overlooked in those accounts. It is the completeness of the exhibition on the opening day. We made a tour of the whole building on Monday, the 17th, and failed to discover one incomplete stand. This refreshing experience, as compared with that at some other Shows, is to the credit of the organisers, but it does not seem, at the time of writing, to have resulted in an earlier arrival of visitors, for the attendance at Birmingham during the first three days was meagre. As to the general appearance of the Fair, it retains its characteristic of representing mainly the mechanical industries of the Midlands, but has perhaps on this occasion drawn more exhibitors from other parts of the country. It is noteworthy that the coal gas industry is very well represented, and that the internal combustion engine is shown to the almost total exclusion of the steam engine, while the electrical industry is not so well represented. Another noticeable development is the increase in the display of plant for the moulding of materials, such as bakelite, into household articles, which involves a considerable amount of machinery. Taken all together, we think that the Fair is the best we have attended, and is worthy of the support which is given to it by the Government.

A Proposed Engineering Museum at Newcastle.

A MEMORANDUM drawn up by the Council of the North-East Coast Institution of Engineers and Shipbuilders, calling attention to the need for an engineering museum in the North-East Coast area, has been laid before the Lord Mayor of Newcastle-upon-Tyne. The Council has submitted in its report that the subject is one worthy of the attention of a committee, which would be fully representative of the varied engineering industries of the Newcastle district, and it has suggested that the Lord Mayor should appoint such a committee, with a view to its meeting at an early date. In the course of the memorandum it is pointed out that the projected museum should contain, not only a record of the discoveries, inventions, and developments connected with the North-East Coast area in the past, but that it should also take the form of a survey of what is being done in the present and what is projected for the future. Many exhibits and relics of both historical and current interest would, it is suggested, be readily offered or could be easily secured. Among them may be mentioned the model of the "Mauretania" and part of the "Turbinia," and working models of such recent developments as the Doxford and Richardsons-Westgarth marine oil engines, together with historical exhibits relating to the development of mining, railway engineering, and iron and steel manufacture in Newcastle and the surrounding district. It is pointed out that buildings already exist in which a collection of exhibits might suitably be housed, and the hope is expressed that steps may soon be taken to carry the plan into operation.

A New Blue Funnel Line Motor Ship.

ON Thursday of last week, February 13th, there was launched from the Cartsburn Dockyard of Scott's Shipbuilding and Engineering Company, Ltd., the new motor vessel "Clytoneus," which has been specially designed for the Java passenger and cargo trade of Alfred Holt and Co., of Liverpool. The new ship has a water line of 426ft. 6in., with a beam of 56ft. and a depth of 31ft. 9in., the measurement being about 6400 gross tons. The hull has been designed to the owner's special scantlings, and high elastic limit steel has been used, which has given a considerable increase in deadweight carrying capacity. The new ship is equipped with the latest navigating and safety appliances, and a feature of her design is the special protective bow. The cargo-handling machinery is electrically operated. A point of particular interest is the twin-screw propelling machinery, which comprises two six-cylinder engines operating on the four-stroke, single-acting principle, with air injection, which have been built to the owner's specified requirements, in association with the North-Eastern Marine Engineering Company, Ltd., and Messrs. Scotts. They will be supercharged on the Büchi principle, each engine exhausting to a separate exhaust gas turbine-driven blower, which will deliver the air under pressure to the inlet valves. The engine cylinders are 620 mm. diameter, with a stroke of 1300 mm., and each engine has a designed fuel power output of 2750 S.H.P. at 138 r.p.m. All auxiliary machinery built for deck and engine-room service is electrically driven, and current will be supplied from four 100-kW, 220-volt oil engine driven generator sets. The steering gear is of the electric-hydraulic type, with an air engine as a standby, which automatically comes into operation should the current fail.

Rural Electrification.

As a result of a request by the Minister of Transport in 1927 that the Electricity Commissioners should make investigations with a view to discovering whether it was possible to proceed with the electrification of rural areas at a more rapid rate than had hitherto been considered possible, the Electricity Commission has just issued a description of what is known as the Bedford Demonstration Scheme. It was stated in the ninth annual report of the Electricity Commissioners that a demonstration scheme for a selected area forming part of the authorised area of supply of the Corporation of Bedford had been prepared. The memorandum now published has been prepared as the result of inquiries received from authorised undertakers and others interested in the development of the supply of electricity in rural areas. The object of the scheme is to provide for the comprehensive and rapid electrification of a typical rural area where mixed farming is the main industry, and where electricity has not previously been available, so that, within a period of about two years, supplies for all purposes will be within the reach of practically all inhabitants. The scheme will thus serve as a local demonstration of the advantages of rural electrification and of the possibility of more rapid development than has hitherto been regarded as economically possible. Based on the 1921 census, the population of the area is 15,860, with 4038 occupied dwellings, and the extent of the area is 101 square miles. The average density of the population is thus 157 per square mile, or practically the same as the general average of 151 per square mile for all rural areas in England and Wales. About three-quarters of the land is cultivated, a large proportion being devoted to corn growing, whilst the remainder is largely pasture land. The area contains two brick-works, which are already connected to the Bedford Corporation's supply system, and account for a substantial consumption of electricity, and other small industries may become consumers in due course. Public supplies of gas are available in only three of the villages.

Telephone Communication Between Ships and Shore.

FURTHER evidence of British maritime progressiveness was provided on Friday, February 14th, when the White Star liner "Majestic," then 1000 miles across the Atlantic and on her way to New York, inaugurated the experimental public service of radio-telephone conversations with Great Britain. The calls from the ship were made through an ordinary telephone in a call office on board, and the speech currents were carried by cable to a radio transmitting apparatus communicating with the Post Office receiving station at Baldock, Hertfordshire. As a result of these successful tests, a public service has been opened between the ship and telephone subscribers in this country. The service is, however, somewhat experimental in character, and for the present it is only available for calls originating on the ship, although it is hoped to extend it on the next voyage to calls originating on the shore. The service will, moreover, be made available for any ship on the North Atlantic route which is fitted with suitable wireless telephone apparatus. The service, which is said to be the outcome of much experimental work, will enable any passenger in the ship to talk at will with any telephone subscriber in Great Britain throughout a voyage between Europe and America. The Rugby wireless station is to be used for transmission to the ship and the Baldock station for reception. In the near future it is hoped to extend the service to Canada, Mexico, and Cuba.

The Chamber of Shipping.

THE fifty-third annual meeting of the Chamber of Shipping of the United Kingdom took place in London on Thursday, February 20th, when the annual report was presented, and Sir Arthur Sutherland, the newly elected President, gave his address. Mr. David Jones was elected Vice-president. A resolution dealing with national economy and the export trade affirmed that the Chamber of Shipping viewed with grave concern the continuing failure of British industries of the first importance to meet the world's markets in price. The urgent need for technical reorganisation, the co-operation of all engaged in such industries, and the enforcement of the strictest national economy were also emphasised. With regard to the development of Empire trade, the Chamber welcomed the calling of a further Imperial Conference, and suggested that a combined effort to increase the production and exchange of goods within the Empire should be made. It called upon the Governments of the Empire to create the necessary machinery for this purpose. The work of the Port Facilities Committee had been noted, and the position had since been reviewed. The Chamber holds the opinion that Government assistance which is granted to schemes for the improvement of ports, port facilities, and equipment, offers to the country results of a higher degree of economic benefit than similar assistance given to any other public work, including roads. It has urged upon the Government the need for affording a maximum measure of assistance to port authorities. Satisfaction was expressed at the further progress made with the ratification of the Maritime Ports Convention and the practical abolition of flag discrimination. The proposal to call an International Diplomatic Conference on the Load Line to complete the work of the Conference on the Safety of Life at Sea was also welcomed.

New President of the F.B.I.

IN succession to Mr. Lennox B. Lee, who has held the office for the past year, the Grand Council of the Federation of British Industries has nominated Lieut.-Colonel Sir James Lithgow as President-elect. Sir James is forty-six years of age. His family has been closely connected with the British shipbuilding industry from sailing ship days onwards, being particularly identified with Russell and Co., of Port Glasgow. Under the management of Sir James and his brother, Mr. Henry Lithgow, the business has grown, and now includes within its scope most of the Port Glasgow yards. In 1912 Sir James was President of the Clyde Shipbuilding Association, and in 1921–22 he was elected President of the Shipbuilding Employers' Federation. Subsequently, he became, first, Vice-president and then President of the National Confederation of Employers' Organisations. In 1925 he represented British employers at the International Labour Conference at Geneva, and in the same year he received the honour of a baronetcy. He has been a member of the Central Electricity Board since its formation in 1927.

Clayton and Shuttleworth, Ltd.

ON Tuesday, at an extraordinary general meeting of Clayton and Shuttleworth, Ltd., agricultural engineers, Lincoln, held in London, a resolution was carried, with one dissentient, for the voluntary liquidation of the company and the appointment of Sir William McLintock as liquidator. The meeting was presided over by Mr. A. G. Foster, who explained that in June last year the Midland Bank, which held the whole of the first debentures of the company and of Clayton Wagons, Ltd., had intimated to the directors that it considered it necessary to safeguard its interests by the appointment of a receiver for both companies. Sir William McLintock had been duly appointed as receiver, and since that date the control of the business had been in his hands. Last month an offer had been received from Marshall, Sons and Co., Ltd., of Gainsborough, for £17,500, for the goodwill and certain debts of the company and a quantity of spare parts. The receiver had no option but to accept that offer, and to enable the sale to be carried out, it was necessary to get the shareholders' consent to the company going into voluntary liquidation. Sir William McLintock submitted a statement of the company's affairs. He stated that the assets were expected to realise £57,185. The Midland Bank's claim would absorb £42,250 of that sum, and there was £6250 due to the Treasury Solicitor. The apparent net assets available for the unsecured creditors therefore amounted to £5185. Their claims totalled £41,150, so that there was a possible dividend for them of 2s. 6d. in the pound. The payment of even that small dividend was, however, extremely doubtful, in view of the difficulty of selling the Stamp End works. There was no prospect of any return being made to either the preference or the ordinary shareholders. The total deficiency as regarded creditors and preference and ordinary shareholders was £835,965. The company's Russian assets had no value at the present time. Something might be realised from them in the unlikely event of the Soviet Government accepting responsibility for the commitments of the Tsarist Government. The whole of its interests in these Russian claims had been assigned by the company to trustees.

Lloyd's Register of Shipping.

IN 1882 Mr. Andrew Scott, the secretary of Lloyd's Register of Shipping, founded a cricket club, the thirty-eighth annual reunion of which took place in London on Saturday last, February 15th. As in previous years, the speech of the evening was made by Mr. Scott, who dealt with several matters of technical interest. Particular reference was made to the special research work carried out by Dr. B. C. Laws, M. Inst. C.E., on cargo ships engaged on North Atlantic voyages, with a view to determining the transverse and longitudinal straining of the hull structure under severe weather conditions. An account of this work was recently given by Dr. Laws in a paper read before the North-East Coast Institution of Engineers and Shipbuilders. Mr. Scott said that although that work had only been in hand for a comparatively short time valuable results were being attained, and as an outcome of the investigations which had already been made, voyages were now being recorded in which there was a complete absence of creaking and straining.

X-Rays in Engineering.

By V. E. PULLIN, Director of Radiological Research, Research Department, Woolwich.

THE subject of the X-ray examination of engineering materials has recently received considerable attention in the technical Press, but the fact that the procedure involved is comparatively unknown has led to many false ideas of its function and adaptability. Let it be said at once that the method has at the present time very real value in engineering practice, but it is open to the grave danger of premature discredit if it is wrongly applied or if the technique is faulty. In America and Germany the subject is being developed intensively, with the result that an impression is prevalent in this country that we are behindhand in this particular branch of science. It is well that such an impression should be corrected. X-rays in the examination of engineering structures have been in constant use in this country since the early part of 1917. From the point of view of apparatus, power, facility of manipulation, and technique the resources of Great Britain are at least fully abreast of those of any other country.

All new scientific methods depend upon the enterprise of practical men for the full and quick development of their usefulness. Unfortunately, in England it has become almost a truism to say that our characteristic conservatism often operates very powerfully to retard progress. It is reported that in Germany there are at least four separate technical education establishments which have inaugurated special courses for the purpose of teaching the technique of radiology in its application to engineering problems. Industrial corporations, both in Germany and America, have adopted X-ray methods thoroughly and therefore successfully.

The function of X-rays shows itself most usefully in preliminary examination of parts before expensive work has been done on them It is this aspect of inspection work which strikes a strange note. It has never been possible before the development of X-rays for the purpose, to investigate the interior of a piece of metal, such as a casting or a forging without destroying it. A percentage destructive test was the best that could be hoped for. There is no doubt, however, that it requires courage to incur certain extra expenditure in production even though it is to acquire definite information where it has never been obtained before. Nevertheless failures and accidents are constant and expensive reminders of the incompleteness of traditional methods.

X-ray examination should also have considerable value in the foundry as a method of investigating castings of new and complicated design. If examined on the spot, and weak areas demonstrated, the designer and moulder are in a position to modify the design and method without loss of time, and when their interest in the job is at its maximum.

It is the purpose of this article to explain the possibilities of radiography, defining its limits from an engineering point of view, and to describe roughly the apparatus and its use, and methods of the engineering radiologist.

There is a tendency to regard an X-ray equipment as something which may be placed on a tripod before a casting or a forging and operated much in the same way as a Kodak—the office boy presses the button, and, presto! in a few moments a picture is forthcoming showing graphically all the different flaws and weaknesses which may exist in the interior of the structure. Needless to say, from this point of view, X-ray results are disappointing.

There is another misapprehension which should be mentioned. Many inquirers suppose that all X-ray examination means X-ray inspection by means of an illuminated screen. A direct visual operation! There are many processes in industry to which visual X-ray examination is both applicable and useful, but, generally, in engineering work the method has but a limited value. It may be used to discover discontinuities and flaws in steel specimens up to a thickness of a quarter of an inch or even a little more. For example, a butt-welded joint of such a thickness would be a suitable specimen for visual X-ray examination, but thicker steel specimens must be examined photographically, or, as it is termed, radiographically, in order to yield useful results. An X-ray photograph or radiograph is not a graphic picture. It is a shadow picture. Materials having different densities are transparent to X-rays to different degrees. It is because flesh and bone have different densities that the surgeon is able, by the appearance of the bone shadow in the radiograph, accurately to locate a fracture or other abnormality. Steel, brass, aluminium, gold, and so on all have different densities, and so they all vary in their transparency to X-rays. The denser a material, the more will it absorb X-rays. Thus it is more difficult to penetrate brass than steel, and it is more difficult to penetrate steel than aluminium. If we radiograph a perfectly flawless and homogeneous plate of steel or any other metal of uniform thickness, the radiograph will show nothing at all. The radiation will penetrate the whole plate uniformly, and consequently there will be uniform action on the emulsion of the photographic plate, resulting in perfectly even blackening unrelieved by any shadow. If, on the other hand, our plate has a hole in it which is filled with air or sulphide or something very light compared with the material itself, then, through the region of the hole, the rays will pass in greater quantity; thus the corresponding area on the photographic film will be more strongly affected than the surrounding emulsion, and a spot of more intense blackening will result. Suppose we fill such a hole with a denser material than the specimen; for example, suppose we fill a hole in a steel plate with solder. In this case the rays will suffer increased absorption when they encounter the abnormality and *fewer* will pass. The result of this on the film will be a corresponding area of *less* blackening. This phenomenon is familiar in radiographs of teeth where gold fillings present such a characteristic appearance. Thus holes, flaws, light inclusions and so on in castings or forgings always appear as dark patches in a radiograph. It must be remembered that radiographs are usually examined as films. In other words, they are *negatives*. If photographic prints or positives are obtained, which they may be in the usual way, then such flaws, holes, &c., will appear as light patches.

Questions are frequently asked by prospective users of X-rays as to the difficulty of interpreting radiographs, and frequently undue apprehension is felt on this score. The inquiry is probably based upon the generally known difficulty in interpreting radiographs of the human body. Here, however, the question is complicated by normal anatomy and pathological conditions which may be present, and these factors, of course, demand a very highly specialised knowledge in their interpretation. It is, on the other hand, comparatively easy to interpret the radiograph of a steel casting having once become familiar with the general appearance of typical radiographs, and the engineer may quickly acquire the habit of judging the size and position of flaws by the appearance of the shadows.

X-rays are, as is well known, a form of light having very short wave lengths. X-rays have not all the same penetrating power. The rays, for example, that would be capable of producing an excellent radiograph of a human arm would be quite useless to radiograph a thick steel plate.

The penetrating power of X-rays depends upon the voltage which is used to generate them, and it is the necessary presence of the high-voltage electrical generator, or transformer, which adds difficulty to the mobility of X-ray equipment. For engineering work in general the voltage required is from 200,000 to 250,000 volts. These figures suggest very large equipment, but it must be borne in mind that the total electric power required is small, only some 5 kilowatts. It is very rare that more than 10 milliampères are used in radiological work for engineering, and a very great amount of useful work may be done with half that current.

Modern X-ray transformer makers have achieved a very high degree of skill in constructing this apparatus. It can now be obtained in small bulk, of high efficiency, and at comparatively low cost. The size of a 200,000-volt X-ray transformer can be as little as 3ft. by 2ft. 6in. by 2ft., and its cost, together with control gear and measuring instruments, should not exceed five or six hundred pounds. The illustration—Fig. 1—shows such a transformer designed and made in the Research Department, Woolwich. The other essential feature of the equipment is, of course, the X-ray tube. The prospective engineering user has here a comparatively limited choice, as his requirements demand very high voltage X-rays. He will require what is called a hot cathode tube. Such tubes are available commercially to work at 200,000 volts, and their price is about £70. Most of these tubes require to be operated inside a lead protective tube box. This accessory adds considerably both to the cost and weight of the equipment, but at the present time it must usually be regarded as an essential piece of apparatus. It may be remarked in this connection that there are excellent X-ray tubes on the market which are self-protected and so require no tube box. It is possible that such tubes will, in future, have the greatest value in facilitating the mobility and flexibility of X-ray applications to engineering, but safety and efficiency requirements imperatively demand expert consideration before deciding on their use in high-power radiology for engineering work at the present time. It will be realised that all X-ray equipment is at very high tension, and therefore its lay-out is important from the point of view of danger and fire risk. This raises the general question of design, and prospective users will do well to secure expert advice in this connection. The routine examination of comparatively small articles may be the requirement of a particular organisation. In such a case a completely enclosed X-ray equipment may be designed for the special purpose in view at a considerable saving of money and increase in efficiency. On the other hand, it may be desirable and profitable to set aside one or two rooms for the purpose of X-ray work if the requirements demand it. In any event, the services of the expert consultant should be enlisted in the first place, both in regard to choice of apparatus and determination of the technique to be followed.

The general question of the applicability and limitations of X-ray methods in engineering practice is

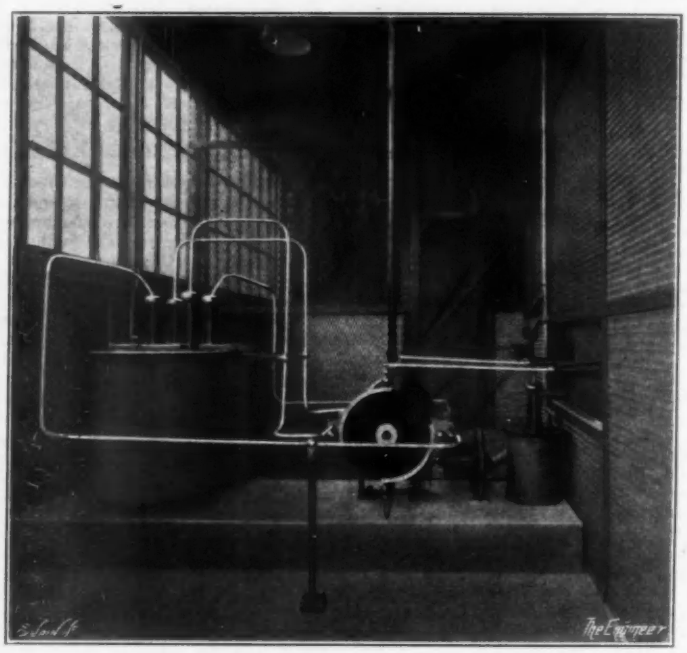

FIG. 1—200,000-VOLT TRANSFORMER AND RECTIFIER

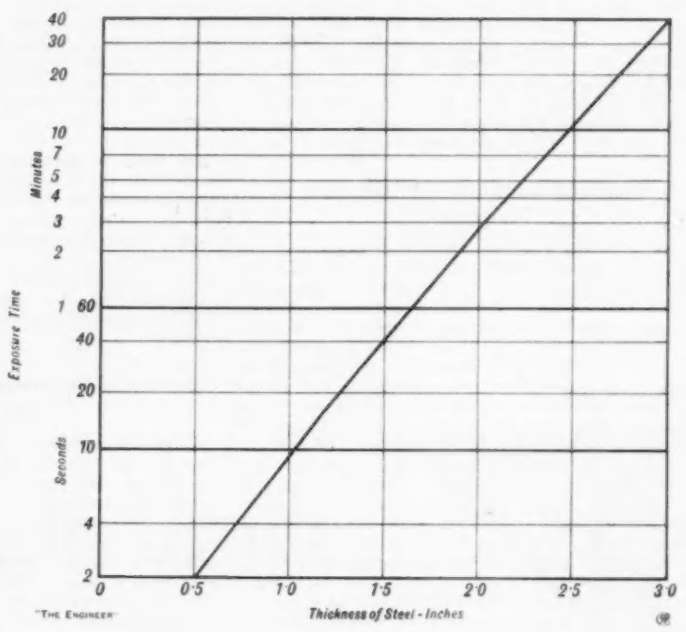

FIG. 2—CHART FOR CALCULATING EXPOSURE

very largely decided by facility of manipulation. It has been the custom to define the progress in this type of radiological research in terms of the thickness of steel that can be penetrated by the rays. This criterion is very misleading from the point of view of practical utility. Although in the laboratory it is possible to penetrate over 5in. of steel, it must not be thought that such penetration can be usefully employed in practice at the present time. It is not an economical proposition. In the present state of X-ray development 3in. of steel is the maximum thickness that can be dealt with in a practical manner. It will be judged by what has been said about apparatus that the X-ray equipment must usually be fixed

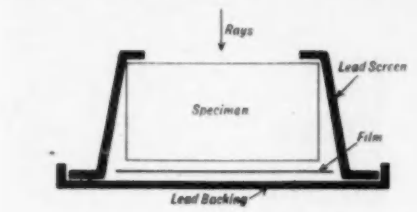

Fig. 3

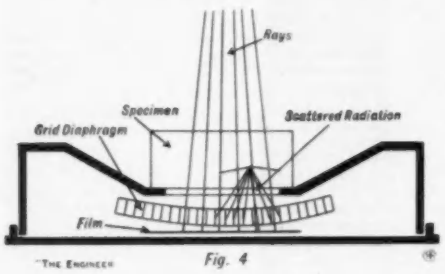

Fig. 4

FIG. 3—USUAL METHOD OF SCREENING FILM
FIG. 4—ARRANGEMENT OF POTTER BUCKY GRID

in position and the specimens brought to the apparatus. Thus the only specimens suitable for X-ray investigation are those which are capable of being lifted and manipulated, by means of a crane or adjustable table, in the vicinity of the X-ray tube. This is the factor which often sets a limit to X-ray usefulness. By the exercise of a little ingenuity, however, quite large structures may be so examined. In the Research Department at Woolwich we have examined very many important castings weighing over 20 cwt., and in one or two cases—to be described later—we have investigated steel forgings weighing over 4 tons. It is generally convenient to make X-ray exposures with the specimen at a distance of some 24in. from the X-ray tube, and the exposure varies from a few seconds up to half an hour or so for thick specimens. Exposure charts, of which Fig. 2 is an example, have been drawn up for the principal metals and serve as a general guide. The exposure, however, varies with the distance between the specimen and the tube, and will often be found to be a matter of experience. In practice, double-coated X-ray films are generally used in conjunction with what are called intensifying screens. The screens are sheets of cardboard or other material coated with crystals of calcium tungstate or a similar preparation, which has the effect of intensifying the action of the X-rays on the photographic emulsion, and so reducing the exposure some fifty or sixty times. The screens may be used over and over again, and have a life of many months in constant use. The films and screens are loaded into a film holder or cassette in a dark room before the exposure is made. There are times when a flat cassette cannot be used, in such cases the film may be wrapped, together with the screen, in light-tight paper. The subsequent development of the films is carried out in the ordinary way, and tank and time development is usually found to be the most convenient.

With regard to cost of the process, the capital cost of the apparatus should be in the neighbourhood of £600 or £700. Depreciation would be amply covered by an allowance of 2½ per cent. per annum for the electrical equipment. X-ray tubes cost about £70 at present, and with care the life of such a tube should be at least 800 hours. Running costs are low. If a cost of 1d. per power unit is taken as a basis, the total power cost should be well under 6d. per hour. The most important cost item in X-ray examination is the film, which works out at about 1d. for 6 square inches. Experiments, however, are now in hand to improve the properties of sensitised paper for engineering purposes, and it seems that the cost may thus be reduced to at least a quarter of its present figure.

Careful consideration of the cost of the process leads inevitably to the conclusion that it will not pay to instal the method for low-grade and cheap products; but for high-grade materials, where lightness and soundness are of maximum importance, it will prove of unique value. The certain knowledge of the soundness of vital parts of an important structure cannot fail to be of supreme importance to the user, and it should have the effect of reducing the—sometimes—unnecessarily high value of safety factors. With regard to the actual technique involved in metal radiography, it is not possible here to discuss the matter fully with reference to the physical principles which play such an important part in the general theory. One or two main aspects, however, stand out and demand attention. The largest area that can conveniently be radiographed at one exposure is about 12in. by 12in., so that in the case of large castings or other articles it may be necessary to make several exposures to cover the desired area. It will be obvious that it is rarely necessary to cover the *total* area of any specimen, but only the parts that by reason of their function, structure, or position, demand careful investigation.

The phenomenon of the absorption of X-rays by materials is a very complicated one, and its discussion in this article would be out of place, but it is most important to notice that X-rays in the course of their passage through any material undergo certain changes which may be regarded as tending to produce fogging and general impairment of the photographic image. From the point of view of the engineering radiologist, two phenomena are experienced which have specially deleterious effects on his work. They are known as scattered radiation and secondary radiation, the first of these being the most insidious in its effect. It is customary to observe certain precautions when making X-ray exposures in order to reduce the bad effects of scattered radiation.

The problem presents considerable difficulty, and manifests itself with more or less severity, depending upon the particular job. The most important point to be observed is to make quite sure that the photographic film is completely screened from all extraneous radiation, *i.e.*, radiation other than that passing through the specimen. In every case the film should be backed by a sheet of metallic lead. If a slab of steel, say, 2½in. in thickness, having a hole in the centre, is radiographed without any lead backing on the film there will be no result, chiefly owing to scattered radiation "creeping" under the film and producing a dense fog. If, on the other hand, the film is laid upon a sheet of metallic lead which absorbs these scattered rays, the hole will be clearly shown. Fig. 3 illustrates the general principle usually adopted in screening the film, but, of course, the shape and disposition of the specimen may necessitate some modification in the actual arrangement.

Scattered radiation which emerges from the specimen also tends to produce fogging, and so to diminish contrast on the negative. In comparatively thin steel specimens such scatter does not impair the negative to any great extent, and may be disregarded. When radiographing thick specimens of light material, for example, aluminium, the results may be improved by inserting a very thin metallic sheet of heavier metal—say, brass—between either the source of X-rays and the specimen, or between the specimen and the film. The function of such a filter is to absorb the less penetrating component of the X-ray beam and to filter out, as it were, the wave lengths that will have no real photographic value. For reasons, which it is not necessary to mention here, however, this method has no advantage when radiographing steel or any of the denser metals.

FIG. 5—RADIOGRAPH WITHOUT GRID DIAPHRAGM

FIG. 6—RADIOGRAPH WITH GRID DIAPHRAGM

Dense metals, such as steel, produce a lot of scatter, and the thicker the specimen, the higher will be the voltage necessary on the X-ray tube, and the greater will be the quantity of scatter that will emerge. Thick steel specimens—of a thickness of 3in. or so—demand special treatment to eliminate the effects of emergent scatter. The most effective way of dealing with the problem is to interpose between the specimen and the film a diaphragm constructed of a series of fine lead slats of appreciable depth placed very close together. Such a diaphragm or grid is known, after its inventors, as a Potter Bucky grid. Its action is as follows:—It allows rays perpendicular to the film to pass—these are the image-forming rays—but rays which emerge from the specimens at other angles—these are scattered rays which produce fogging—are caught and absorbed by the highly absorbent lead slats. The diagram—Fig. 4—shows the operation of the apparatus. The disadvantage of the diaphragm I have described is that images of the lead strips are recorded on the film, but usually these images do not impair the usefulness of the radiograph, which, on the other hand, gains considerably in detail and contrast. Figs. 5 and 6 are radiographs of a plate of steel 4in. thick, having an aluminium cross placed on the top. Fig. 5 is obtained without a Potter Bucky grid, and Fig. 6 with one. The images of the lead slats do not appear in Fig. 6 because the grid was caused to move slowly over the photographic film during the exposure.

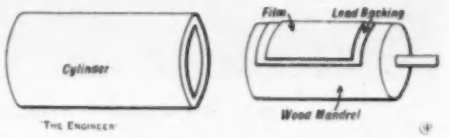

FIG. 8—CYLINDER AND WOOD MANDREL

As research in radiology proceeds and it becomes possible to examine thicker metallic articles, the difficulties, owing to scattered radiation, will increase, but

FIG. 7—PORTION OF A STEEL FORGING SHOWING LEAD IDENTIFICATION MARKS (BLACK) AND INTERNAL FLAWS (WHITE)

theoretical considerations suggest that the proper use of grid diaphragms will enable useful photographic contact to be preserved for considerably thicker specimens than can be radiographed at present.

and in order to obtain close contact between the surface and the film, it is often convenient to construct a wooden mandrel of suitable size covered in lead foil. The film may then be attached to the

immerse it in a liquid which is very opaque to the rays, having an opacity for preference about equal to the specimen. A suitable liquid of this kind for steel specimens is a mixture of lead acetate and lead nitrate.

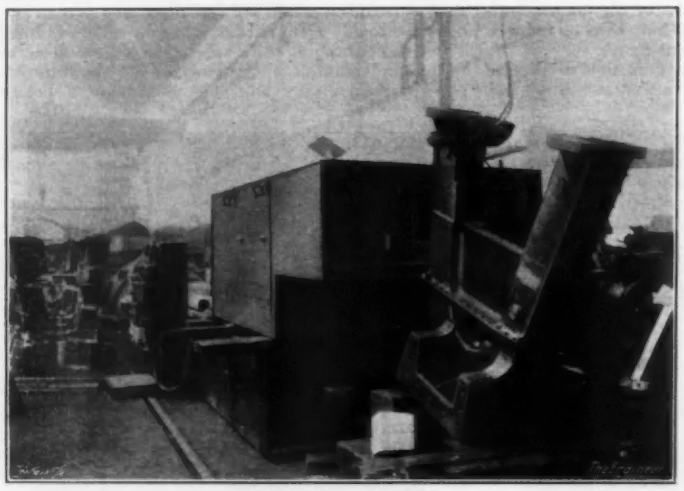

FIG. 9—TRANSPORTABLE X-RAY SET

FIG. 10—30FT. FORGED STEEL CYLINDER

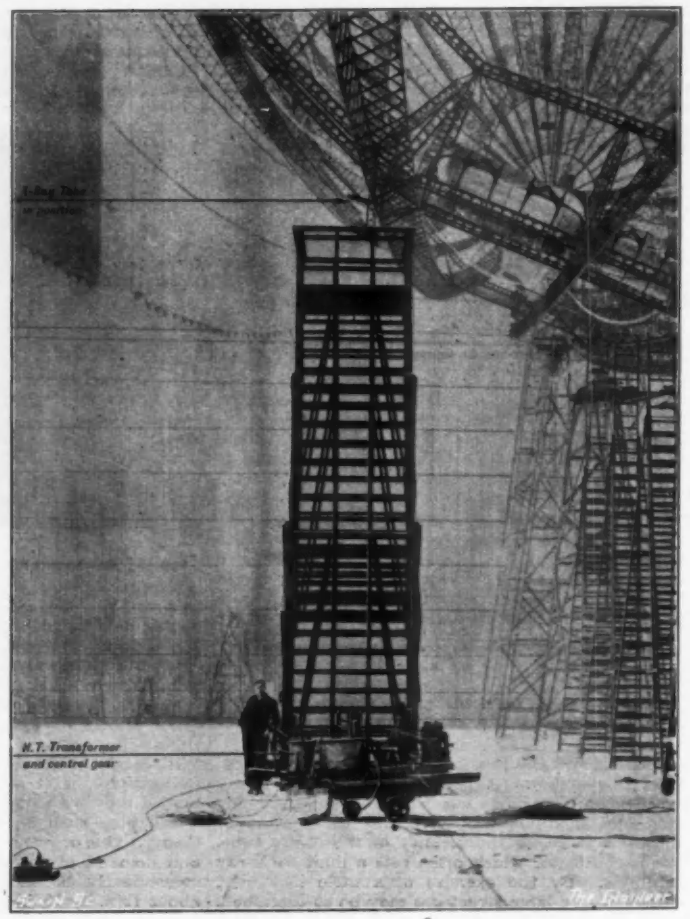

FIG. 11—RADIOGRAPHING FRAMEWORK OF AIRSHIP R 101

In order to achieve good results, the film should be placed in good and close contact with the surface of the specimen. In cases in which the surface concerned is large and flat, very little difficulty is experienced,

mandrel and pushed up the cylinder to the required position—Fig. 8. Pliable intensifying screens may be obtained which are specially suitable for this type of work. Another difficult type of specimen is the small

The specimen should be covered with a thin layer of wax before immersion, as this solution has a corrosive action. An opaque wax for similar use may be made by mixing red lead, clay and oil. It is frequently

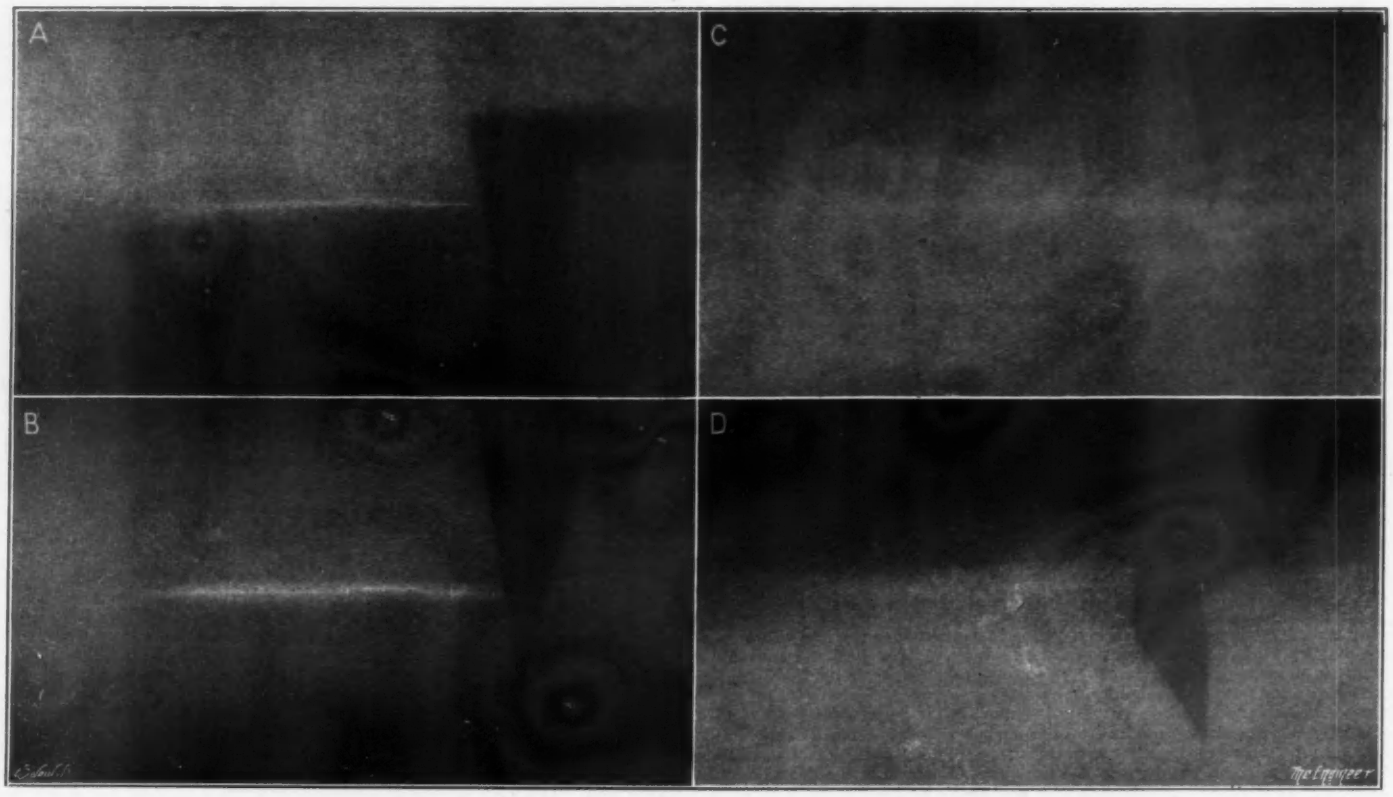

FIG. 12—FOUR STEREOSCOPIC RADIOGRAPHS SHOWING CRACK IN FORGED STEEL CYLINDER

but when dealing with irregularly-shaped articles greater care is required, and it may be necessary to cut films to special small sizes to fit parts and areas not easily accessible. One very common article for radiography is a cylinder. Here the film is placed inside,

irregularly shaped object, in which the thickness of metal varies from part to part. To attempt to screen such an article with metallic lead and at the same time preserve its outline would be impossible. A very good way of dealing with such a specimen is to

necessary to radiograph a metallic object having a varying thickness. This is never an easy problem, and it is impossible to lay down any general rule for its solution. Experience is the best guide, but the most expeditious way of tackling the matter in the first

place is to screen off all the thin parts with lead sheet and initially expose the thick parts; then, without moving the object or the film, to remove the lead covering from the thinner parts and proceed to give them their appropriate exposure. It may be that this method will introduce unsightly lines, caused by the edges of the lead covers, but in engineering radiology it will be found that very often the beauty of a radiograph must be sacrificed to its utility.

It is usually safe to predict that in a thick specimen of iron or steel a flaw which has dimensions of 3 per cent. of the total thickness of the part radiographed will show perfectly clearly. In thinner specimens, however, say, up to ½in. of steel, very minute cracks and flaws are capable of being shown. Fig. 7 is a radiograph of such a specimen, a portion of a steel forging. The marks shown on the radiograph proved on examination to be almost microscopic lines of sulphide inclusion in the middle of the steel.

It must be remembered that flaws which are in the plane of the incident X-ray beam are much more likely to show in a radiograph than those at an angle to it. This fact is important in the case of cracks, and a complete radiographic examination involves exposing the specimen several times, with the rays at different angles of incidence.

That a high-power engineering X-ray equipment is capable of certain mobility is illustrated by Fig. 9. In this case the equipment is made as a self-contained unit. It was designed and made in the Research Department, Woolwich, as a portable set. The castings which are illustrated weighed some 16 cwt. each, and were manipulated for the purpose of radiographic examination by an overhead crane. Another application of X-rays is not without topical interest. The Inspection Department of the Air Ministry, in order to secure positive knowledge of the soundness of certain important joints of the airship "R 101," after assembly, requested me to arrange for their examination by X-rays. This investigation involved using a high power X-ray tube at a height of from 40ft. to 60ft. above ground. The examination was successfully carried out, and the soundness of the joints put beyond all doubt. Sensitised paper was used, and each radiograph developed on the spot. Fig. 11 shows the X-ray equipment in position in the airship shed. Fig. 10 shows a forged steel cylinder some 30ft. long, the weight being 4 tons and the thickness of the walls nearly 4in. In the course of machining the cylinder, a small axial mark was observed inside, and about half-way along its length. It was required to know whether this was a crack, and, if so, to ascertain its depth. Stereoscopic radiographs were obtained, and by a simple geometric method the depth of the crack was calculated from the radiographs and shown to be about 0·4in. Fig. 12 shows the four stereoscopic radiographs that were obtained.

I have endeavoured to give some idea of the scope and utility of X-rays in engineering practice from the aspect of radiography in the gross examination for flaws in structures. The subject of X-ray crystal analysis, which investigates the ultimate fine structure of materials, is also of the highest importance to engineering and metallurgical science. These two aspects of radiology are quite distinct, and should not be confused. Both have great possibilities, but whereas crystal analysis is essentially a matter for the physical laboratory, radiography has now reached a stage in its development where it may be placed with confidence in the hands of the practical engineer for every-day use.

In the Research Department, Woolwich, crystal analysis is being studied in relation to steels and other metals, but it is yet early to form an opinion as to the practical interpretation of the results. It is probable that in the course of time the X-ray spectrometer will be as familiar in engineering workshops and laboratories as the microscope, but that will not be until the significance of its findings has been definitely interpreted in terms of mechanical properties.

Poland's Access to the Sea: The Ports of Danzig and Gdynia.

By THEODORE RICH.

QUESTIONS regarding access to the sea for independent states have for many years proved to be a source of strife and controversy, and even now the problem is exercising the energies of several Governments. In the later Middle Ages, Danzig was one of the most important seaports in the Baltic, exceeding Hamburg in trade, and through it passed a large proportion of the export trade to the then kingdom of Poland, a great deal of it coming down the Vistula. A map of Poland, showing the railways and natural resources, is given in Fig. 1. Danzig, apart from some time under the Teutonic Knights, was taken over by Germany at the second partition of Poland in 1793, and, with a divided up hinterland, the city began to lose its relative position. After the Great War, Pomerania was returned to Poland, forming what has been termed a "Corridor," while Danzig with the surrounding country, with a population predominantly German, was made into a free city, the province of West Prussia being therefore cut off from Germany by a strip of country about 60 miles in width.

In 1918 the Allies decided that an independent Poland with free access to the sea formed part and parcel of their programme, and although Poland wished for the absolute control of Danzig, a compromise was arrived at and a free city was created. Germany, after the revival of Poland as a State, encouraged an attitude of pin-pricking on the part of the business community of Danzig towards the latter country; when Poland was invaded by the Bolsheviks, facilities for the landing of munitions, &c., at Danzig were refused, and therefore means were sought by which access to the sea could be obtained which did not pass through the territories of the Free City.

At Gdynia—the German Gdingen—sheltered behind

"THE ENGINEER"

FIG. 1—MAP OF POLAND SHOWING MAIN RAILWAYS AND NATURAL RESOURCES

the Hell Peninsula, was a site for a new port, which could be cheaply developed. A railway loop was made which enabled Danzig territory to be avoided altogether, so that, if the Danzigers continued a policy of hostile passive resistance, there would still be a purely Polish outlet, if required. We therefore find a new port being developed, the origin of which lay in national commercial strategy.

The city of Danzig has lost a certain amount of its importance and revenue which it obtained as an important centre of German civil and military affairs, but, on the other hand, it has gained because recently so much more business in connection with Poland has been directed to it. The city lies on the western side of the delta of the Vistula, close to what was at one time the main stream, before it made a more direct path for itself to the sea. An engineering feature of the city is the remarkable crane house, with hoists operated with large walking drums, which dates back to Hansa League activities in the fifteenth century.

The trade of Danzig increased in the form of tonnage handled from about 2 million tons in the years preceding the war to 8 million tons in 1928, the registered tonnage of shipping increasing from under a million to over 4 million tons in the same time. Coal covered about 5½ million tons in exports in the same year, followed by about a million tons of timber, a material export being sugar. Of the imports, iron ore for Polish steel works takes an important place and about half a million tons of scrap is also handled. Before the war coal was imported by sea from Westphalia and England, whereas, now, coal from Polish Silesia is the largest export. To handle coal exports and ore and tin-plates imports, a special group of quays, aggregating 600 m. in length, has been constructed. The coal trucks are tipped endways, two at a time, into hoppers with belt conveyors and loading gantries, the coal being passed through shoots designed to minimise breakage. The ore and phosphates are handled with the aid of long-span gantries and grabs. The total area of outer and inner harbours at Danzig amounts to 2200 acres, the depth in the fairway being in general 9 m. to 10 m. There are seventy-six wharf cranes and four shipbuilding yards, the two largest belonging to the International Engineering Company and Messrs. Schicau respectively. Some of the timber exported comes down the Vistula in rafts.

The city of Danzig, which with the rural territory allotted to it covers about 1800 square kilometres, has about 400,000 inhabitants. It is controlled by a High Commissioner under the League of Nations, the Harbour Board being controlled by five Danzig and five Polish representatives under the chairmanship of a Swiss Colonel. During the last few years the people of Danzig have begun to realise that, as in the past, their future depends on the friendly co-operation with Poland, despite continuous propaganda exercised in the opposite direction by outside influences. The city of Danzig has its own money of 25 Gulden to the £1. Except for certain monopoly commodities, such as alcohol and sugar, there is free trade between Danzig and Poland, the city being within the Customs boundaries of Poland, but the extraordinary thing is that, despite this fact, the prices of commodities in the Free Territories are very high. The wages for unskilled labour are about 1·30 gulden per hour, or about 1s. 0½d. Poland has access to the docks, it controls the railways outside the dock area, the administration of the river Vistula, and undertakes the foreign relations of the city.

Before the war the policy of Germany was to encourage trade from the interior towards Stettin and Königsberg, the chief railways being designed to run east and west to miss Danzig. The existence of the

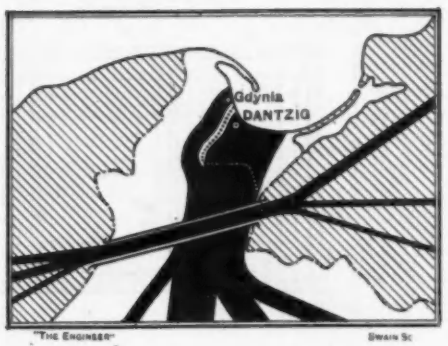

FIG. 2—DENSITY OF TRAFFIC IN THE CORRIDOR

frontier of Russia across the Vistula tended to divert trade, that port being then only about the twelfth of German trade. There was, however, a certain export of timber, grain, and beet sugar from Russian Poland, a large proportion of the traffic passing west to ports relatively close at hand for transhipment. To-day, there is direct communication with many countries formerly unrepresented, and the merchants of Poland are now dealing, to a much larger extent, direct with exporters in Russia and the Far East than they used to, the control by houses in German ports being greatly diminished. The city in traffic is now fourth port in the Baltic, coming after Copenhagen, Gothenburg, and Stockholm.

The changes in the nature of the imports tend to

show the improved buying power of the Polish people, while the very great increase in the quantities of artificial manures and Chile saltpetre imported indicate the improvements in cultivation which have taken place. Poland used to import a material quantity of medium-grade iron ore from Germany by rail, but an export tax was put on it, and Polish iron-works began to obtain ore in increasing quantities from overseas, especially from Sweden, Morocco,

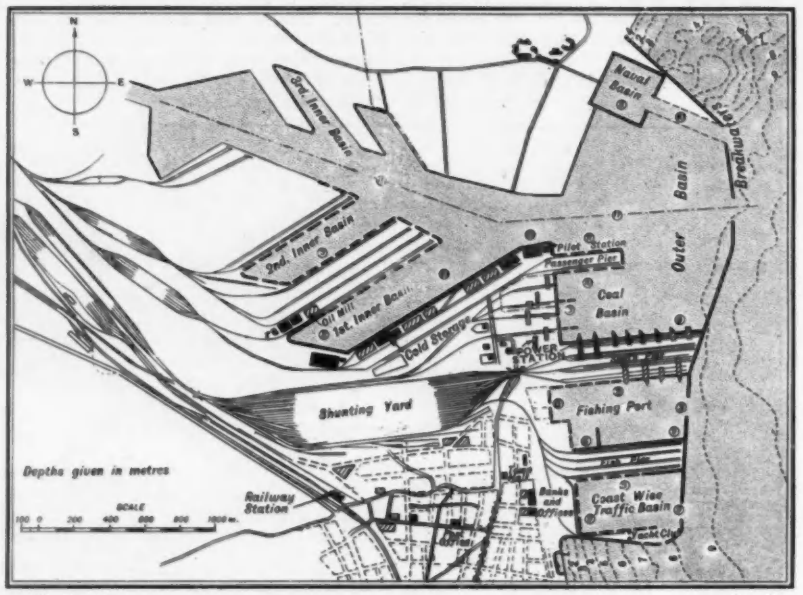

FIG. 3—PLAN OF THE PORT OF GDYNIA

Spain, and Greece; the export trade in coal tending to provide both-way freights, especially regarding the Mediterranean. A convention with Germany concerning scrap having expired, Polish steel works have gone much further afield for their requirements, many cargoes arriving from France, Great Britain, Denmark, the United States, and some even from Japan. It is of interest to note that, owing to the better warehouse, exchange, and merchanting facilities, the bulk of the cotton and wool for Poland is imported *viâ* Bremen. At one time a material part of the timber exported was in the round, having been floated down the Vistula, but the bad state of the river after the war diverted much traffic on to the railways and encouraged the export of cut timber.

Regarding coal, in 1925 Germany refused to continue to allow the importation of half a million tons from Polish Silesia, and overseas markets were therefore sought. The general strike in Great Britain introduced many markets to Polish coal, so that, whereas in 1924 Danzig imported 104,000 tons, twice as much coal as it exported, in 1928 the imports were 35,500 tons, while the exports were 5,370,000 tons. This great increase in trade necessitated improvements regarding docks, quays, crane, and other equipment. Loans were negotiated, guaranteed jointly by the Free City and the Government of Poland; some money was recently raised in England for port improvements. It is worthy of note that, while Germany has made many efforts to estrange the

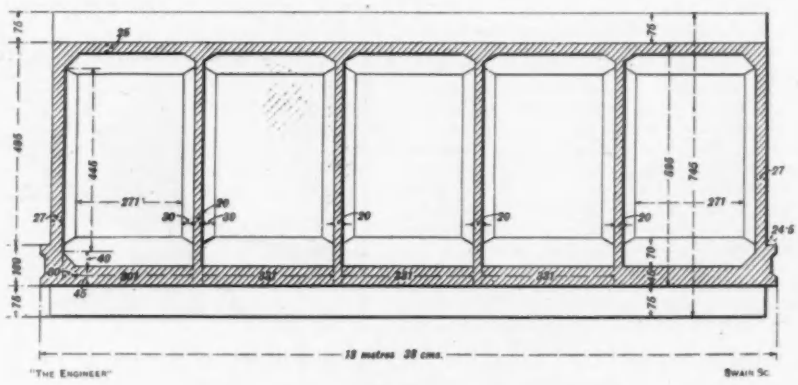

FIG. 4—SECTION OF CAISSON FOR BREAKWATER

people of Danzig from Poland by granting very exceptional railway traffic terms, it has simultaneously tried to divert Polish traffic from that port to Bremen, Hamburg, Stettin, and Königsberg. Quite an appreciable amount of traffic now reaches tide-water, *viâ* Danzig from Czecho-Slovakia, over 300,000 tons being so handled during 1929.

The continuous increase in the traffic handled altered somewhat the ideas regarding the new port of Gdynia. The congestion at Danzig was at times serious, and it can be well understood that in view of the way that labour and other troubles can nowadays be engineered by professional paid agitators, Poland wished to have a "second string." The work at the purely Polish port of Gdynia, 21 kiloms. to the west, which had been started in a somewhat languid fashion, with the idea that it should act primarily as a supplementary port and, secondarily, as an economic safety outlet, was therefore, from the year 1926, pushed forward with energy. There is also a small Polish port on the Vistula, Dirschau, situated close to the boundary of Danzig territory. It is intended primarily for short-distance coastwise barge traffic.

A good deal has been heard about difficulties regarding the so-called Corridor of Pomerania, which gives Poland territorial access to the sea, the strip of country which at its upper end is about 50 miles wide, has a population that is 80 per cent. Polish, and during the last fifty years of Prussian control has always sent a Polish deputy to the Reichstag. Solid trains are passed from Germany to West Prussia over several routes, the passengers requiring neither passports nor customs examination. The goods haulage charges are the same as those on the German railways; there is even a German military train once a week. The diagram—Fig. 2—of Casimir Smorgozewski, shows the relative traffic through and across the Corridor, and although an Arbitration Court was arranged for, the only important question to be handled during the ten years it has been in existence has been that regarding the responsibility for a railway accident.

Some people have said that it is hard for the Germans of East Prussia to be cut off from the Fatherland, the population of the former being measured in hundreds of thousands, whereas Poland's free access to the sea affects about 30 millions of peoples. It may be mentioned that, although there is a regular steamer service between Stettin and Königsberg, while over half a million passengers pass across the Corridor each year, only a few thousands go by boat, showing that the inconvenience of passing over a foreign strip of country cannot be very great.

THE PORT OF GDYNIA.

The port of Gdynia is situated on what was formerly an arm of the sea running into the land between low hills. In course of time the water area was covered with sand and a layer of peat. The harbour mouth faces due east, it is protected inland by hills from the north, and seawards to the north by the Hell Peninsula, a range of sand hills about 20 miles long, 10 miles from the harbour mouth, only a few hundred yards wide in many places, that tends to form a natural roadstead outside Gdynia and Danzig and to give protection against north-westerly gales. There is therefore a good roadstead outside the harbour.

It is connected to Danzig by a direct line of rail; to Kartusy and to the south by a line outside the limits of the Free City boundaries, and will shortly be connected to the colliery and steel areas of Polish Silesia, with the aid of a series of cut-off sections now under construction, aggregating 160 miles of new line, to reduce the distance to be hauled, and ease the gradients. The distance to the chief coalfield is about 400 miles. Beyond a fishing village there was nothing on the site in 1921. The situation is healthy. Up the valley there is ample room for dock extensions for 6 kiloms. from the sea, and space is available for the eventual construction of a large city. It is only under exceptional conditions, like those prevailing last winter, that the port is closed by ice, although, of course, trade will every winter be restricted to the ice-free ports of the Baltic. Last winter ships were

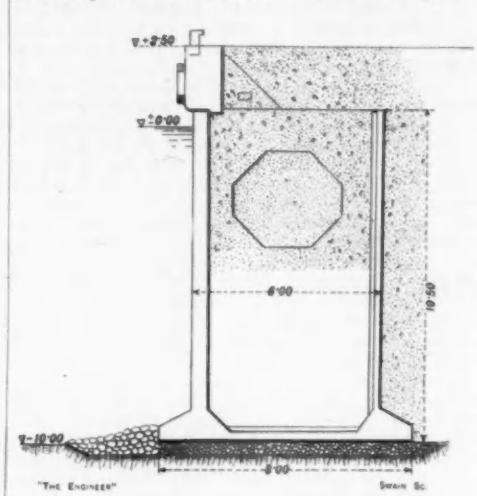

FIG. 5—SECTION THROUGH QUAY WALL

frozen up beyond the Hell Peninsula, and had to be provisioned with the aid of aeroplanes and sledges.

The hills towards the harbour mouth are about 2½ kiloms. apart. Pits have been opened in the hills on the north side from which good gravel, sand, and moraine boulders are obtainable.

A plan of the harbour is given in Fig. 3. The quay walls and breakwaters which have been completed are shown in full black, while those under construction are indicated by broken lines. Buildings under construction are shown hatched. The work was started in a small way in 1921, but it was taken in hand energetically in 1924, and in 1925 a Franco-Polish company was formed, allied on the French

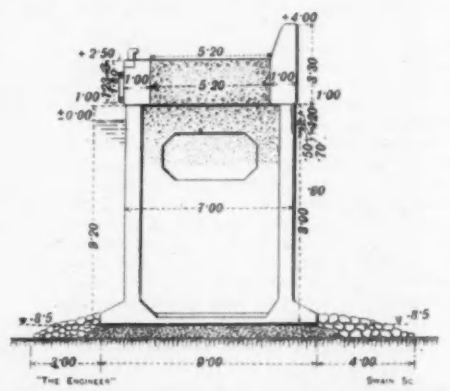

FIG. 6—SECTION THROUGH BREAKWATER

side to the Cie de Battignolles of Paris, to take over the work. The methods now used are as follows:—

The site for the waterways are first attacked by a bucket dredger which bites away the top layer of peat, about 300 years old, which is put into hoppers and dumped out to sea. The dredger cuts away sufficient depth to float itself, and it is followed up by suction dredgers which, except at bad places, cut away to the required depth. When making the harbour works the remains of a ship, loaded with munitions, sunk centuries ago in the war with Sweden, were found. The bottom is a hard sand, with a certain number of moraine boulders in it—some of large size—and gravel below, the site in geological times having been covered by a glacier. At first some big boulders gave trouble, owing to the necessity at first for blasting them—an expensive underwater operation—but it was arranged to get over the difficulty by dredging a hole to one side of each and letting the boulder drop in.

The methods of construction of the quay walls and breakwater are decidedly ingenious. The general construction consists of oblong caissons of reinforced

concrete which are floated to site and sunk in position, although certain quays are made up with a concrete raft supported on wood piles with an underwater facing of sheet piling. There is no tide in the Baltic, and the maximum fluctuations in water level, which are due to wind and barometric variations, do not exceed about 18in. That factor naturally affects dock wall design, as there must be a tendency towards equilibrium in pier walls on each side. Where there are large tidal variations in ground with a low angle of repose, there must be a tendency towards the pushing of a dock wall over.

The caissons are built for depths of water of 8 m., 9 m., 10 m., and 12 m., in general 6 m. and 7 m. wide, towed away to the site required. Many scores of caissons have been built row after row on sand in places now covered with deep water. The expenses of launching are therefore, so to speak, nil, as the sand on which the caisson is made has to be pumped away anyhow. The quay wall or breakwater site is dredged level and covered with a layer of large shingle. The caisson is towed to the site, and is sunk by syphoning in water. The top of caisson is arranged about 20in. above water level so that, if the caisson is not quite in line or is out of level, the water can be pumped out with a centrifugal pump until it floats again. The breakwater caissons have vertical keys at each of the four corners, which are filled with concrete, the quay

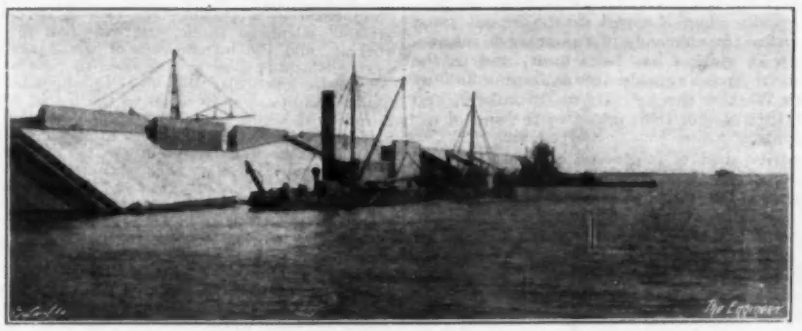

FIG. 7—DREDGER SUCKING SAND FROM TOE OF CAISSON

the length overall being 18·40 m. Figs. 4, 5 and 6 show some views of some of them. They are stiffened up with four partitions, openings being made in the lower corners for levelling the water and trimming when floating, towing, and sinking. Some of the first caissons were made with nine compartments in lieu of five, but the floating and other stresses were too much for them. They are built on sandbanks, which are ultimately to be dredged away to make part of the dock. There is a vertical double armouring of plain steel bars, with diagonal bracing bars. The bars used are 10 mm. diameter, 25 mm. apart, in a double layer in the caisson partitions, the bars on the bottom are 14 mm. diameter and on quay faces or breakwater

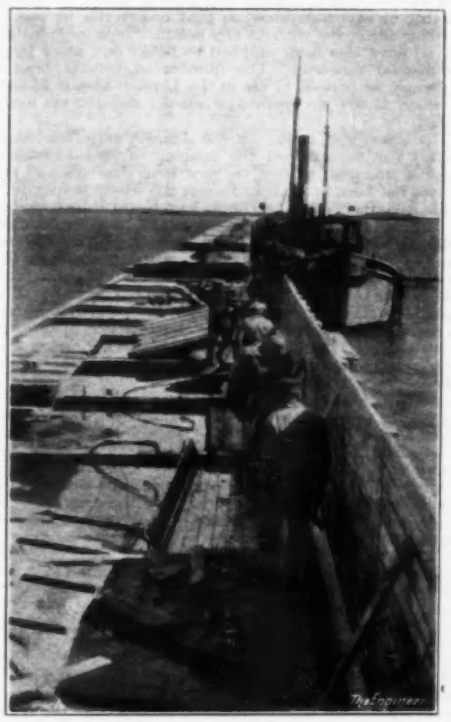

FIG. 8—SHUTTERING ON CAISSONS FOR FORMING QUAY WALL

faces 12 mm., 10 mm., and 7 mm. diameter. The pressure on the foundation is 1½ kilos. to 2 kilos. per square centimetre. In the partitions some diagonal bars, 25 mm. diameter, are used. The largest caissons weigh 700 tons.

Fig. 12, page 216, shows a series of caissons under construction. An electrically-driven concrete mixer and an elevator are used on the work. Fig. 13 shows a form collapsed and removed sideways after casting. Long wooden rods are used for tamping the concrete around the bars in the sides, back walls and partitions. Between 400 and 500 caissons have been made up to date.

Fig. 7 shows caissons being floated. A wood cofferdam, about 4ft. high, is placed across the lower edge of the caisson while on its side, and a suction dredger draws away the sand from under the outer toe. The caisson slowly tips downwards and when sufficient sand has been sucked away it will float, and is caissons only have keys at the front ends. The outer face of the breakwater is thickened up. It may be mentioned that water in the Baltic contains only 6·8 per cent. of salt.

Fig. 8 shows caissons in place with vertical shuttering being erected for building up the top face of the quay wall. The steel bars shown are bent into place and used to reinforce the concrete gussets built up at each end wall and diaphragm. Fig. 14 is a short section of built-up dock face. The copings are made with granite blocks from Tatra in the Carpathians or from Sweden, and the caissons are stiffened up at the parts where bollards are placed. As can be seen in Figs. 5 and 6, the caisson toes are protected with large boulders The caisson rests on a layer of stones half a metre thick, carefully levelled. When sunk they are filled with sand pumped out of hopper barges. A double timber curbing is bolted on the quay face, the bolts being cast-in ready. When a quay wall has been made, the space behind is filled partly by floating in hoppers with sand dredged from the dock, and partly by pumping direct from hopper dredgers over the quay through long steel bolted-up pipes—see Fig. 15, page 216.

The Baltic coast of Germany has been celebrated for centuries for its amber, which is fossil gum. When the suction dredgers have cleared their holds, people without shoes and stockings go into the semi-liquid sand and look for amber. The largest hopper suction dredger carries 1300 cubic metres of sand, and makes six to seven fillings per day of twenty-four hours. The bucket dredger, which deals with the harder material, is kept going right through the winter as long as hoppers can be got to it. Last winter, owing to the extreme cold, general work was hung up for nearly three months. So far, 12 million cubic metres have been dredged away. When the first section of the works on hand are completed, there will be 3000 metres of quay wall with 10 m. of water, and 2600 m. with 9 m. of water, besides a certain amount with 8 m. The plans provide for an ultimate quayage of 13 kiloms. Work is at present proceeding night and day.

It looks as if this system of self-launching light-shell caissons, which has proved to be so exceedingly convenient at Gdynia, could, with modifications, be used for tidal harbour work, like, for instance, that in progress at Southampton. By making a series of openings after sinking, internal stresses could be avoided, and the caissons could be filled as required vertically from the face or horizontally with concrete, to weight it or stiffen it up if required, to enable it

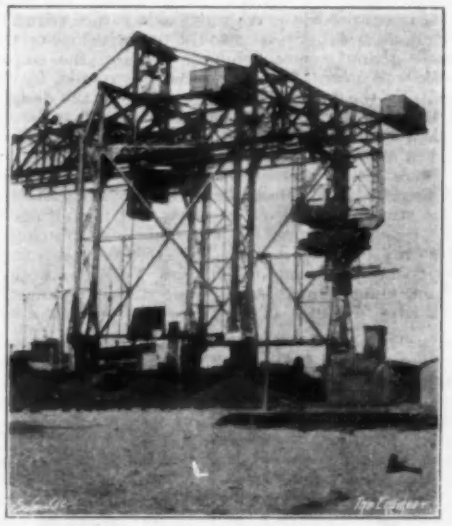

FIG. 10—COAL HANDLING GANTRY

to withstand the overturning stresses set up by tidal variations.

The port of Gdynia was opened for traffic as soon as the first section of quay was ready, and the business done is already at the rate of about 2 million tons per year, mostly coal exports. Power for operating the cranes and for lighting the harbour is supplied by the Pomeranian Power Company, through a transmission line, 140 kiloms.—say, 87 miles—long, from a low-

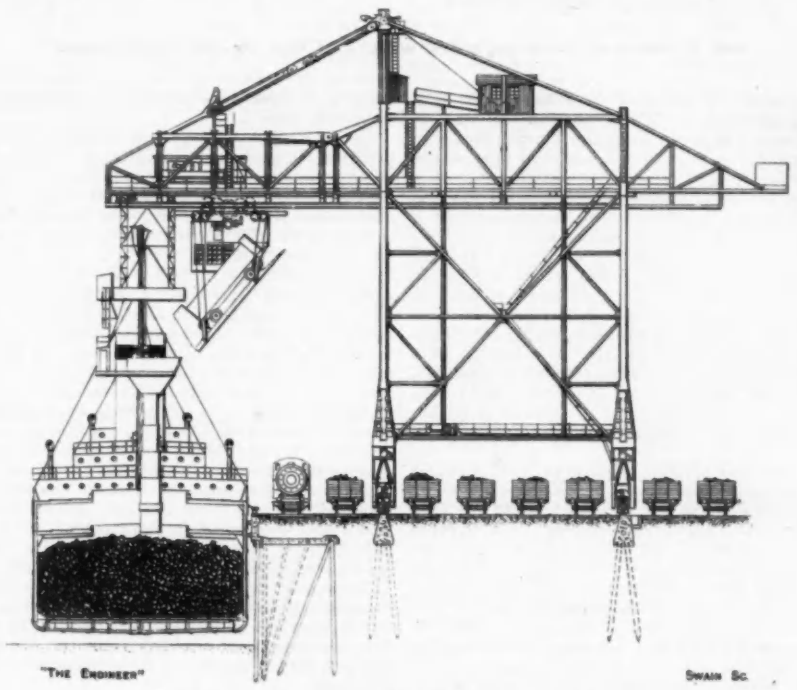

FIG. 9—COAL HANDLING GANTRY ON QUAY WALL

fall station at Grodek, with a present capacity of 5000 kW. The line is arranged for 100,000 volts, but is at present operated at 60,000 volts. A sub-station has been erected to the west of the docks, and in it the current is stepped down to 15,000 volts and transmitted to a sub-station near the coaling quay. The cranes and hoists are operated with three-phase, 50-period current. There is an auxiliary Diesel engine set of 300 kW capacity for emergency purposes. To avoid the use of long flexible cables, a conduit is run along the quays to convey the three-phase current.

The policy adopted has been to let certain sections of quay space to colliery and other groups for a term of

years, and to supply power for the operation of cranes, &c. For example, the Robur Coal Company has taken over 600 m. of quay length and the Geische Company 200 m. Fresh water for harbour and shipping purposes is drawn from a well by electricllly driven pumps, and is elevated to a central water tower. There are at present in operation on the main coaling quay, two long span transporter gantries, with electric cranes and grabs, two short open gantries with cranes above and grabs, and a coal tipper.

The latter—Figs. 9 and 10—which operates on the earlier section of quay wall, is arranged with a cradle to handle wagons containing 17 tons of coal. The truck is hauled on to the cradle with the aid of a capstan, the cradle is lifted and turned round, run over the ship and the truck end tipped into the hold. A telescopic shoot is suspended from the overhanging arm of the tipper, and can be used when the quality of coal makes it desirable. After tipping, the truck is returned towards an empties track, turned round in the cradle and dropped on to the track, a slope on the cradle giving sufficient impetus to run the empty truck well clear. The hoist was constructed, in the main, by the Laura Hutte, of Silesia, to the designs of the Demag Company, of Duisberg. There is one little difficulty, and that is that the Polish trucks have oil-box axles, and when tipped the oil runs out.

There are at present three general transit sheds, all arranged with electric cranes, one alongside the pilot station with electric cranes and the others in the inner basin. The first-named is intended, primarily, for a new line of 12,000–15,000 ton steamers, the Scantic Line running to New York, *viâ* Copenhagen, under the American flag, at first fortnightly and, later, weekly. It is anticipated that cotton, and

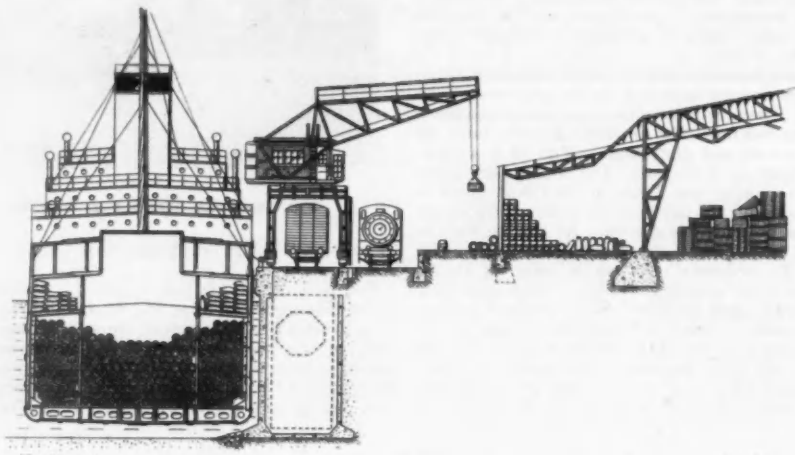

FIG. 11—SECTION THROUGH QUAY WALL AND ONE OF THE WAREHOUSES

motor car parts for assembly in Poland, will form important shipments. When the writer was at Gdynia, a cargo of scrap from the United States of America was being unloaded, a material part of the "junk" being formed of superannuated motor cars. Fig. 11 is a section of one of the warehouses showing dock construction. There is quite a natural amount of Polish influence in the United States, and it is interesting to know that arrangements are being made to handle Polish goods to the United States of America to inland stations in the United States on through bills of lading and *vice versâ*. A building has been arranged to deal with the emigrant traffic and negotiations are taking place for the arrangement of a Customs-free quay for traffic to Czecho-Slovakia. The works are being carried out under the supervision of Mr. T. Wenda, the Government Engineer to the Commission charged with the port undertaking.

There is a rice cleaning, husking, and grinding plant, with warehouse alongside, taking up 140 m. of quay, designed to import direct from the Far East and handle 100,000 tons of rice per year. It is operated electrically, the machinery being of German type. The mills are on a thirty-five years' lease. It may be explained that even in Burma much of the business in rice is in the hands of German merchants.

To handle much of tropical and other edible oils and fat products for Poland, a factory will be shortly erected alongside the rice works. A cold-storage warehouse, having a capacity of 15,000 tons, is now being constructed. It will be used largely for handling export agricultural products, such as eggs, butter, and bacon. A tobacco factory for dealing with the State monopoly business is projected. Space is arranged for shipyards; a floating dock and floating crane are now available.

Very extensive railway sidings have been laid out, so that, in time, the annual business handled may reach 4000 tons per lineal metre of quay per year. The rail transport costs are very low, being only about 4s. a ton from Silesia to Gdynia town sidings. The port dues and trimming costs are also low. The wages for unskilled labour at the present rate of exchange work out at about 6d. per hour, although in Poland the cost of living is not as high as with us. The local rates of money of about 15 per cent. tend somewhat to offset the low rates of labour. At present about 1200 men are engaged in coal shipping in three shifts.

A start has been made with a Polish merchant marine, colliery interests having purchased several cargo boats and being engaged on building more. A certain amount of coasting and tourist trade is also carried on. An Anglo-Polish company has been formed with the co-operation of the Ellerman Wilson Company, which is running weekly direct passenger and cargo steamers to London and Hull from Danzig, and these vessels will pick up cargo at Gdynia also, as the general trade of that port develops.

On the north side of the harbour a naval establishment, with a small naval basin for the craft forming the Polish Navy, has been built. Apart from any value it may have from the point of view of coast defence, and showing the flag, a naval establishment must tend to increase the efficiency of a mercantile marine. A neat railway station has been built, and in the summer time there is a considerable amount of holiday traffic from Warsaw through Thorn, Bromberg, and Danzig to Gdynia, and then round to the end of the Hell Peninsula.

A locomotive shed of reinforced concrete, to hold sixteen locomotives, has been erected, and an electrically-operated turntable, to carry 180 tons, has been provided. It is fitted with a capstan so that locomotives not under steam can be hauled on or off the turntable into the bays.

There has been some question about the operation of the reconstructed line to Silesia with electric traction, but at the low current cost of coal and labour and the comparatively high cost of money in Poland and heavy electrical traction apparatus in world markets, the present would seem to be hardly the time to embark on a project of somewhat doubtful economic value.

In order to encourage new industries, following a practice adopted in a number of cases in Canada, special local and other tax modifications are offered to those starting industries in the new city. It is anticipated that a large city will be developed alongside the port. The Government early in the day took over the docks site, of very little agricultural value, leaving land to the north for city development. The rural consumers, formerly controlling the area, were first joined together for local government purposes, but the problems to be handled proved to be almost beyond the capacity of a rural body, so the Government has taken a hand in affairs to assist in the town planning and other work. Drainage works are now in progress, a fine post office with an automatic telephone system and a few fine buildings, have been erected. Water is being obtained from an up-to-date system of tube wells sunk into the lower sands. In the lower town, when drainage work is to be carried out, a series of vertical tubes are first driven for 15ft. or 20ft., and connected in multiple to an electric or petrol-driven centrifugal pump and the local water level lowered before the excavation is started.

There has been a good deal of land speculation regarding the city sites, some land has been sold at 4 to 6 American dollars a square metre. This speculation has, however, subsided, since the State reduced the percentage advanced on mortgages for building purposes.

The general situation of the city and port is good; there are many sites for good suburbs, and there is some fine country close at hand. It is not often that in Europe an opportunity to lay out a new city occurs, and it is somewhat a pity, therefore, that the town site was not taken over by the Government from the start, for in that case the difficulties which must arise when an early haphazard lay-out of streets has to give way to town planning worthy of the name, might have been avoided.

In Gdynia one is struck with the almost Transatlantic spirit of optimism which exists. It is modern Poland's first effort to make a port, and the progress inside about five years has been extraordinary. A worthless bed of sand and peat has been turned into docks now handling 2,000,000 tons of traffic a year, ships are to be seen outside waiting for berths at the quays, and the Poles seem to be anxious to show to the world, by their efforts, that the inspiration and independence they received with the assistance of the Allies, has been in every way justified.

Telephone Progress in the London Area During 1929.

THE statement issued by the Post Office of the telephone progress in the London area during 1929 makes interesting reading. The outstanding features of the year were the great increase in the range over which telephone communication is possible, the rate of development of overseas telephone traffic, the extension of automatic working, and the introduction of the "personal call" service which enables a subscriber to pass a telephone call for the particular individual to whom he wishes to speak. Additions were made to the list of countries in Europe with which communication is possible from Great Britain, the Transatlantic service to North America being available to most of these countries, *viâ* London.

The direct exchange lines provided increased from 181,606 in December, 1921, to 384,739 in December, 1929, *i.e.*, an increase of over 110 per cent. in eight years. The continued growth of the system is further illustrated by the fact that there are now 137 exchanges in the London area, as compared with 130 last year. This number includes 24 automatic exchanges, 109 manual exchanges, two toll exchanges, the trunk exchange, and the tandem exchange. There was an increase of 28,756 exchange lines during the year, which is about 8 per cent., the total on December 31st being 384,739. In addition, there are 16,641 private telephones, *i.e.*, telephones provided by the Post Office, but not connected to the public exchanges. The total number of telephones—exchange and private—in the London area at the end of 1929 was 661,977, which represented an increase of 47,794, or 7·8 per cent.

Subscribers in London and the United Kingdom generally, do not appear to make as much use of the telephone as subscribers in some other countries. The use of the long-distance telephone system by trade representatives in America as a substitute for visits to secure sales, finds little or no counterpart in this country. Neither is the telephone used locally for shopping and similar purposes to anything like the extent that obtains elsewhere. Special telephone facilities have been designed for "order departments" of large business houses, and the London telephone service is always ready to give advice to those who wish to develop that side of their business on the most efficient lines. Many of the large departmental stores are fully alive to the advantages of shopping by telephone, and have had large installations provided with an ample number of exchange lines, so that orders can be placed by their customers without any delay. Some large installations have also been supplied to banks and other large commercial concerns. The number of private branch exchanges at present in use in the London area is 28,086, of which 27,954 are operated manually and 132 are automatic.

The growth of traffic on the Transatlantic telephone service has necessitated the opening of two additional wireless channels. There are now four channels and the service has been extended to cover the whole twenty-four hours each day. The maximum number of calls recorded on any one day during the year was 140, of which 81 were outgoing and 59 incoming from America, but usually the number of calls from America exceeds somewhat the number to America. The service has been extended on this side of the Atlantic to include Ireland, Czechoslovakia, Italy, Austria, Gibraltar, and Ceuta in Spanish Morocco; on the other side service is now open to the principal towns in all parts of Canada. A service between London and Buenos Aires by alternative routes has also been established. The provision of line and switching facilities for the continental traffic has increased considerably the number of towns with which communication can now be established. The "personal call" service is now available to all countries on the Continent to which there is telephone traffic, with the exception of Switzerland.

The London trunk exchange deals with the traffic which circulates from the London area over the long-distance lines in this country, and on such routes it is necessary at present for the calls to be dealt with in turn according to the times at which the calls are booked. The toll exchange deals with traffic circulating between the London area and the nearer provincial towns, and the calls are, as far as possible, connected "on demand," as in the case of a local call. It is part of the general policy of the Post Office to extend, as far as is economically possible, the area served by the toll exchange, and in pursuance of this policy 221 lines to various provincial towns were transferred during the past year from the trunk to the toll exchange. As a result of the transfer of these circuits from the trunk to the toll exchange, the traffic handled in the trunk exchange has been reduced to some extent, and this has enabled improvement to be effected in the methods of handling the longer distance calls. The average number of calls of all classes handled in the London trunk exchange daily during 1929 was 60,050.

The "personal call" service was first introduced on the inland trunk service on August 1st, 1929, and at the present time about 600 outgoing and 200 incoming personal calls are dealt with each day in London. There has been a considerable increase in the use made of the fixed time call service under which calls are accepted to mature at a specified time. During 1929 a substantial reduction in charges for trunk calls was made in respect of calls to towns more than 200 miles distant. An alteration was made in the method of charging for trunk calls for distances exceeding 35 miles. Telephone communication was established with the Isle of Man, and a direct route from London to the Isle of Wight was opened.

The area served by the toll exchange has been extended by the inclusion of towns formerly served by the trunk exchange. The toll exchange now serves the south-east portion of England, from Aldeburgh and Felixstowe on the East to Portsmouth and Milford on the South Coast. The northern boundary of the area embraces the towns of

Diss and Bedford, and the western boundary includes Bicester, Basingstoke and Southampton.

The outgoing traffic from London to towns in the toll area is dealt with at an exchange known as toll A, and the total number of provincial lines connected to this exchange was increased from 939 lines in 1928 to 1177 in 1929. The incoming traffic from the same area is dealt with at toll B exchange, and the number of provincial lines connected to the latter exchange increased from 690 lines in 1928 to 898 lines in 1929. Part of the increase is due to the transfer of territory from the trunk exchange. The more rapid service possible under toll conditions has resulted in a marked increase of telephone traffic in the area transferred. The total traffic dealt with daily in the toll exchange was 122,125 calls, representing an increase of 27 per cent. over that of the previous year.

The number of local calls originated during the year 1929 was 647,631,825, an increase of 9·3 per cent. over the figure for 1928. In pursuance of the policy of assisting subscribers to secure a high grade of service on their own installations, over 100 operators employed by subscribers have been trained in private branch exchange operating procedure. The number of "phonograms"—*i.e.*, telegrams handed in by or delivered to the public by means of the telephone—shows an increase of 8·6 per cent. over the number dealt with during the previous year, an increase which indicates that telephone subscribers are realising more fully the time-saving value of the telephone when used in connection with the telegraph service. During the year the number of phonograms received at the Central Telegraph Office was about 2,250,000, an increase of over 10 per cent. on the number for the previous year.

Substantial progress was made in the conversion to automatic working of subscribers' lines within the 10-mile radius from Oxford-circus. In this area about 18 per cent. of the whole number of lines are connected to automatic exchanges, as compared with 6 per cent. at the same date last year. Approximately one-quarter of the total originated calls in the London area are now dealt with wholly or partially on automatic equipment.

The equipment at nineteen of the existing manual exchanges has been increased, and the following new manual exchanges have been opened:—Pollards (relief exchange for Norbury area), Upminster, Molesey, Sutton, Valentine (Ilford area), Emberbrook (Thames Ditton area), Stanmore, Hornchurch. The aggregate capacity of manual exchanges has thus been increased by 13,000 lines. Preparations are being made for extending the manual equipment at ten exchanges, and seven additional manual exchanges will be opened during the year 1930.

The construction of buildings for new manual exchanges is in hand at half a dozen other places, and sites have been secured or negotiations for purchase are in hand for eighteen additional automatic or manual exchanges, and search is proceeding for suitable sites for fifteen more exchanges.

The total length of single wire provided for subscribers' lines and local junctions is now 2,792,344 miles, an increase during the year of 119,367 miles. A new trunk cable to Southend has been laid to supplement the existing service and provide for the rapid development which is taking place on this route.

During the year telephone repeater stations were opened at Portsmouth and Tavistock for service to the South and South-West of England respectively, and at Liverpool, Blackpool, Port Erin (Isle of Man), and Belfast for service to the Isle of Man and Northern Ireland. To meet the growth of traffic and to provide for new exchanges opened during the year, 10,000 additional junctions were provided, making a total of approximately 50,000.

Spending and Saving.

THE following leading article from our American contemporary, *The Iron Age*, will be read with interest by all who have followed the recent letters in these pages on the subject of Deferred Payments.

Various preachments of the new era exponents, who did the cheer leading in the late boom in securities prices, have been under revision in the past three months. Not so much has been said, however, of the exaggerated emphasis put during the boom months on the spending of the worker's pay. According to the new era economists the wage-earner's function is to spend his wage. Commonly there was the inference that the high rate of wages mattered little so long as the wage was applied to the maintenance of mass production on an ever-increasing scale.

Certain British commissioners who were sent to find out why the United States so continuously enjoyed good times were told in some quarters that much of our prosperity was due to the high wages paid here and to the large percentage of the wage total that regularly made the circuit from manufacturer, by way of the pay envelope, on through the various channels of consumption of goods back to the producer's treasury. While this explanation had in it a strong suggestion of lifting one's self by one's bootstraps, it was put forward with a marshalling of consumption statistics that gave it much weight.

At the same time there came along a propaganda against thrift. One economist, so-called, pointed out that thrift was no longer the virtue it had commonly been thought. Just as the Menckens were glorifying self-expression as the newly discovered way to character building, the apostles of the new economics were telling the wage earner that to come into his best estate he must widen his horizon by freely spending his wage. Thrift may have been well enough in Poor Richard's day, but in the bright lexicon of the new era it was listed only to show that it had become obsolete. Henry Ford, with his familiar fondness for being different, averred that "much of the advice given to young men about saving money is wrong," adding: "I never saved a cent until I was 40 years old."

It may be true that the American wage and the American standard of living call for at least one motor car in every family. We would by no means limit the satisfactions to which American workers may aspire. These should steadily increase, as they have long been increasing. But in the present interval between the country's most demoralising boom and the period of sounder prosperity which we believe is just ahead, it is in order to question whether in recent years, and particularly in 1929, there has not been a good deal of overspending for consumption goods, a good deal of buying of things which the buyer could not afford. While in the management of corporations saving has been stressed as never before, and additions to surplus have been pointed to as proofs of prosperity and wise administration, the new era teaching has put the financing of the individual consumer in an entirely different category.

The wide acceptance of the new doctrine of free spending naturally went with the belief that each succeeding year would see production and consumption at a new height, the consumer's buying power growing meanwhile by what it fed on. But now that the pace has slackened, more heed will be given to the relation between individual saving and increase of the national wealth in fixed capital. Public works now scheduled by State and Federal Governments and the new construction planned for 1930 by public utility, industrial and building corporations call for far more capital than has been so applied in any recent year. It remains to be seen to what extent, as the result of lessons lately learned, individual savings will supply this need and at what lowering of the 1929 outlay for certain forms of consumption goods.

SIXTY YEARS AGO.

THE apathy which existed in some quarters sixty years ago to scientific developments in directions affecting public welfare and health is convincingly illustrated by a note in our issue of February 25th, 1870. The British Association had appointed a committee to undertake a practical and comprehensive inquiry into the treatment and utilisation of sewage. A circular letter inviting assistance towards the cost of carrying out the investigation was addressed to 663 corporations and boards of health. No response at all was received from 418 towns and districts. Three replies were received in which actual disapproval of the inquiry was expressed. Some bodies, including the Metropolitan Board of Works, declined to contribute anything to the cost of the investigation, on the ground that they had no legal authority to disburse the ratepayers' money for such a purpose. A few others were unwilling to contribute to the committee's expenses because, so they said, they already possessed sewerage works and had arrangements in force for the utilisation of the sewage. Twenty-three bodies merely acknowledged receipt of the letter without comment one way or another, twenty-five wrote deferring a decision, and 116 refused their support because of their alleged poverty, because they held that the inquiry ought to be conducted at the expense of the country generally or for other reasons. Contributions were received from 81 towns, the total amount received being £786. Well at the head of the list was Manchester with a contribution of £100, Halifax and Plymouth coming next each with £30. Others contributed various sums down to two guineas. With a contribution of £50 from the Association itself the committee decided that it was in a position to begin the inquiry, but that additional assistance would be required if the investigation was to be extended. Its first step was to ask the subscribing towns for a statement of the nature of the difficulties which they encountered in the treatment and utilisation of their sewage. That the subject which the committee proposed to investigate was at that time one of pressing public importance may be gauged from an incidental reference elsewhere in the same issue to what was then happening at Becton on the Thames, where was situated the outfall works for Northern London's main drainage. Sewage mud had accumulated on the bed of the river at this point to a depth of 10ft., 15ft., and even 20ft. Of its character workmen employed on the Gas Light and Coke Company's new works close at hand had no doubt. It was sometimes impossible to hold the sewage back until after high water. A heavy rainfall would fill the reservoir and would necessitate the opening of the sluices before the tide had ceased to run up the river. On such occasions the dark line of sewage could be seen travelling upstream towards Woolwich. On the turn of the tide the sewage stream stopped and such of it as was not deposited began to travel back again and so passed down the river to the sea.

THE "CATADYN" METHOD OF WATER STERILISATION.

A NEW means of sterilising water, to which the name of the "Catadyn" method has been applied, is being introduced into this country by Duncan Stratton and Co., whose London office is Sentinel House, Southampton-row, London, W.C. 1. For the purpose of exploiting the invention in the British Empire, a separate company, to be known as the British Catadyn Company, Ltd., is being formed.

It has been known for a long time now that certain metals had a germicidal property. In the 'eighties of last century, the Swiss biologist, C. von Naegeli, discovered that if water infected with micro-organisms were kept in metal—silver, copper, &c.—vessels, the organisms were killed provided the water remained in the vessels for several weeks. He called the phenomenon, for the occurrence of which he could discover no explanation, "Oligodynamics." Numerous investigators continued to make researches into the subject, but without making any material advance. Recently, however, a Munich physicist, Dr. Georg A. Krause, succeeded in determining the reasons underlying the action of oligodynamic metal upon such organisms, and also in raising the activating power of such metals and greatly increasing the speed at which the eyact.

Dr. Krause, in describing his discovery, states that various metals, such as silver, copper, aluminium, &c., in laminated molecular form, accumulate active molecular oxygen in quantities depending on the quality of the surface. This oxygen generates metal salts which go into solution in the form of ions and kill the bacteria by transmission of the electric charge.

Owing to its catalytic-dynamic properties, this method of sterilisation has been called by Dr. Krause the "Catadyn" method. He employs, as the active metal, silver prepared in a special manner, which, it is claimed, is particularly well suited to the purpose. The method of preparing the metal has not been disclosed to us, but the material, which we have had the opportunity of examining, has the appearance of having been quenched from the molten state by being dropped into some cooling liquid. Silver, it is explained, is the metal possessing the most potent bactericidal properties, and has the advantage of having no deleterious effects on the higher cells. In use, the silver gradually wastes away, but at an exceedingly slow rate, the outlay for metal being, it is stated, only some ·00005d. per litre of water treated.

It is claimed for the method that water once treated cannot be re-infected and, further, that if a small volume of water treated by a 2-hours' contact with the metal be added to a much larger volume of infected water, the whole becomes sterilised in 24 hours. At present, the method has only been commercially used on quite a small scale—for private houses, &c.—but it is proposed to extend its scope considerably, one of the first applications to be made being to ships' potable water tanks.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE INTERPRETATION OF SPECIFICATIONS.

SIR,—A standard specification lays down various tests to be met by materials, and these tests are supposed to be severally indicative of different properties to some extent mutually exclusive or contradictory. If in materials for certain purposes the engineer considers that the tests should indicate that the material reaches a certain minimum standard in one property, the manufacturer realises that excellence in that property reacts to the detriment of some other characteristic, and is actuated by this knowledge in his co-operation with the engineer in formulating a specification to govern the material. That such a compromise between the desires of the engineer and a reasonable caution of the manufacturer is the basis of most specifications often seems to be overlooked in the application of the specification in the actual process of inspection and test. An increase in the tensile strength or in hardness as indicated by the tensile test is usually accompanied by a reduction in the elongation and reduction of area, and where an increase in both tensile strength and elongation is required material has to be put into a different condition by treatment, or a different material must be used, or both these alternatives be combined.

An example of this is seen in the British Standard Specification for Railway Tires. Here, in Classes B, C, D, and E, with an increasing tensile strength or hardness there is a reduction in the elongation and in the deflection expected under the falling weight test. It may be said that the properties of the material indicated by the elongation and falling weight test are those properties which cover reliability and safety of the tires, while the tensile strength or hardness bears relation to the wearing life of the tires. Taking Class E, with a tensile of 69 tons, an elongation of 8 per cent., and a deflection represented by the formula $\frac{D^2}{60\ T^2}$ are considered an indication of the necessary minima properties giving safety. In Class B, 42 tons tensile is apparently considered as soft as the commonest class of tires should be, and with this an elongation of 18 per cent. and a falling weight deflection of $\frac{D^2}{45\ T^2}$ are considered ample evidence of the same properties. What would appear desirable from the engineer's point of view would be a combination of the highest figures obtainable of these tests representing respectively the greatest wearing property with the necessary safety.

The writer would suggest that specifications should be interpreted as relating to minima figures only. He does not suggest that a minimum elongation of 8 per cent. in Class E should be combined with the minimum tensile of 42 tons in Class B, as a total of 50 would indicate some inferiority; and therefore, with minima figures of tensile and elongation and falling weight deflection, he would include a minimum total of tensile and elongation for each class.

It is difficult to understand why tires ordered by an engineer to Class D specification should be considered unsuitable on the score of excessive hardness when the tests give a Class E tensile with an elongation equivalent to the Class C requirements, and a falling weight deflection equivalent to Class B requirements. It is not reasonable to suppose that 13 per cent. elongation and a deflection equivalent to $\frac{D^2}{45\ T^2}$ is any less evidence of safety when coupled with 69 tons, than when obtained with 55 tons—rather the contrary.

These particular figures and this particular specification are taken only as an example and it is suggested that all specifications should be understood to mean the minima figures mentioned, or better. The unreasonable insistence on narrow limits of all test figures is a handicap, and often very expensive handicap, on the producers, without giving any advantage to the consumers—rather the reverse, as materials may be, and indeed have been, accepted, after treatment, on tests within the specification, but considerably inferior to tests previously obtained which happened to be just outside the specification limits. Further, this insistence on the observance of top limits tends to a standardisation of material, whereas if specifications were taken as applying to minima figures the way would be left open to manufacturers to obtain the best combination of the two contradictory groups of tests.

ADVANCE.

The British Industries Fair.

No. I.

WE published with our last issue a Special Supplement dealing with some of the exhibits at the Birmingham section of the British Industries Fair, which was opened on Monday last. To-day we publish two additional Special Supplements descriptive of further exhibits, and below we begin to refer to other machines and apparatus that are to be seen at the Fair.

PNEULEC, LTD.

There are two new foundry machines on the stand of Pneulec, Ltd., Mafeking-road, Smethwick, Birmingham. They are a high-speed electric swing-frame grinder, and a jarr, rollover moulding machine.

The grinder, which we illustrate in Fig. 1, is a development of the earlier Pneulec machine, and is claimed to be the only machine which has the wheel rotating at right angles to the frame and which is not belt operated. The advantages of these features are that the fettler has a much better sight of his job, and the machine is easier and more flexible to handle. It will be observed from the illustration that the machine has a clean outline and is substantially built. It is balanced with the weight so distributed as to assist the fettler during grinding without exertion. The drive is supplied by a 5 H.P. totally-enclosed motor, and the starting gear is of the robust design necessary for foundry use. The main shaft is carried in two sets of double-row self-aligning ball bearings, and the roller chain which drives the main shaft runs in an oil bath. The motor housing and all other castings, except the oil bath chain case, which is of aluminium, are in cast steel.

In the new Pneulec moulding machine the impact is not made by the table striking on a small area just around the top of the cylinder, and contrary to most machines the cylinder takes no shock at all. The table and base are so designed that the shock is evenly distributed all over, and that is effected in the following way. On the bottom of the table plate there is a number of machined bosses, and in the base at corresponding points are machined pockets in which are fitted hard rubber pads covered by steel discs. When the table falls, impact is made over a big area, and there is the same intensity of jarr over the whole of the pattern table. The blow is solid, and is entirely free from spring or rebound. The rubber pads ensure resiliency and prevent metallic shock on the box. In addition to the bosses on the jarring table there are in each of the four corners machined guides which fit during the jarring operation, and there can be no wobble or getting off centre. This method of construction gives guide and support at five points instead of one. On account of the fact that the force of impact is distributed over the whole area of the table plate, it is possible to use a much lighter section plate than the heavily ribbed plate which is ordinarily used. This naturally makes the machine more economical to operate, and gives it a jarring capacity which is said to be from 20 to 40 per cent. greater for similar sized cylinders.

The rollover portion is an entirely separate machine, and where a plain jarring machine has been installed the rollover can be added at any subsequent date without in any way interfering with the foundations of the jarring machine. The features of the rollover and pattern-draw attachment are its positive and smooth action. These operations are hydro-pneumatically controlled. The pattern-draw cylinder is equipped for fast and slow drawing, and the automatic self-equalising device on the top of the cylinder ensures that the box leaves the pattern absolutely square.

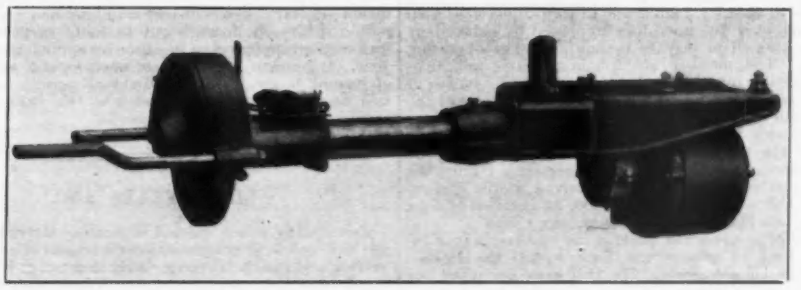

FIG. 1—HIGH-SPEED, ELECTRIC, SWING-FRAME GRINDER—PNEULEC

In addition to the foregoing there are also Pneulec Royer sand mixing machines to be seen in operation. There are several minor improvements in the construction of this machine over that exhibited at the 1929 Fair, but the main principle of operation remains the same.

W. H. ALLEN, SONS AND CO., LTD.

An exhibit of more than usual interest on the stand of W. H. Allen, Sons and Co., Ltd., of Queen's Engineering Works, Bedford, comprises two examples of a new type of light-weight, single-acting, airless-injection oil engine. The engine, which has recently been put on the market, has been specially designed for land and marine work, and is a very compact unit of high output. The view—Fig. VIII., which we reproduce in to-day's Plate Supplement—illustrates the smaller of the two engines exhibited at Birmingham, in course of its brake test at the firm's works. Actually, it is coupled direct to a 220-volt, 65-kW Allen compound-wound, direct-current generator, and is shown in operation. This particular unit is one of a range of two to six-cylinder engines, with designed outputs of from 65 to 200 B.H.P. at normal running speeds up to 600 r.p.m. In Fig. 2 two sectional views of the engine are given, which show the principal working parts. The bed-plate and crank case, together with the cylinder jackets, form one single casting, within which the cam shaft and the fuel pumps are also contained. Each of the cylinders has a bore of 230 mm., with a stroke of 300 mm., and the designed piston speed is 6 m., corresponding to 600 revolutions per minute. Particular care has been taken in designing the crank shaft, which is of the solid forged type. It is so dimensioned that the range of normal running speeds is below the major critical speeds, with any grouping of cylinders. In the case of the two and three-cylinder arrangements, which give free couples, balance weights attached to the crank cheeks as shown are provided.

All the main bearing shells are of steel, and they are white metal lined. The bearings are secured to the bed-plate by long bolts. As the drawing indicates, an H section connecting-rod is employed. It is of cast steel. The connecting-rod bottom end bush is of gun-metal, with a white metal lining, and for the top end bearing a "Delta" metal bush is used. The crown of the piston is deeply dished, in order to obtain a compact combustion space and the piston is provided with internal ribs to give a light but strong construction. Both the gudgeon pin bearings and the body of the piston are finished by grinding, and the piston carries four top rings and one oil scraper ring. The gudgeon pin is of the floating type, with aluminium end plates. The cylinder liners are finished in a special honing machine, which gives them a high polish, and we understand that with the highly

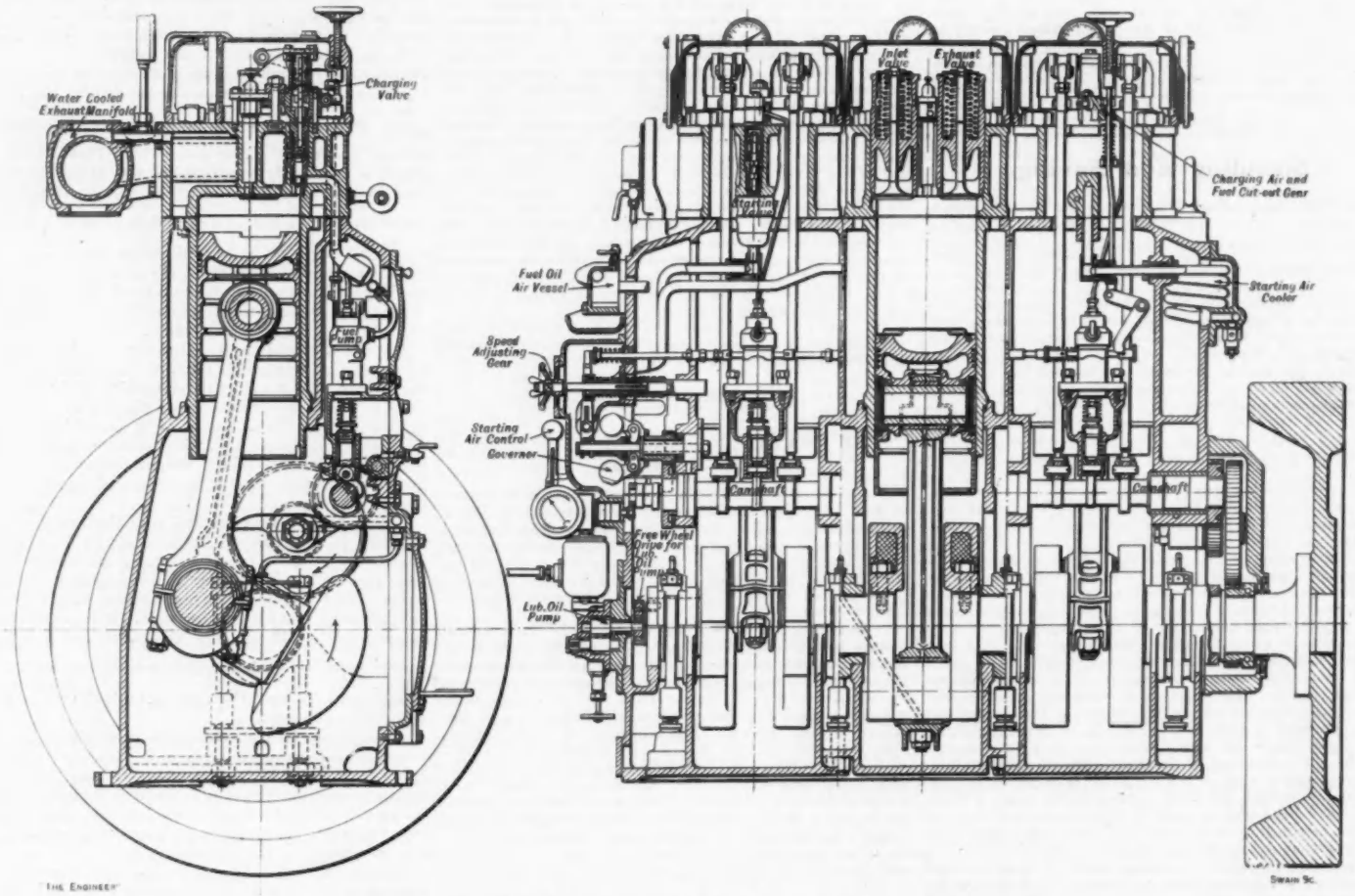

FIG. 2—100 B.H.P., THREE-CYLINDER, AIRLESS-INJECTION OIL ENGINE—ALLEN

finished surfaces of the liner and piston it is possible to employ with safety very fine clearances, with corresponding good compression. The piston and connecting-rod are so arranged that they can be conveniently withdrawn through the large inspection door, an arrangement which makes the engine particularly suitable for 'tween deck spaces.

A particular feature of the new design is the neat way in which the top of the liner is secured to the cylinder head, so as to provide ample water cooling around the combustion space. With the increased cooling given by this arrangement, higher mean effective pressures with larger overloads are possible.

All the castings for the cylinder heads, pistons, liners, and valve cages are made in "Perlit" iron. The arrangement of the air inlet, exhaust, fuel, starting, and charging valves are shown in Fig. 4. It will be seen that the top of the engine is completely enclosed by a light casing of aluminium, which can be quickly removed for inspection of the working parts. The cam shaft is gear driven from the crank shaft,

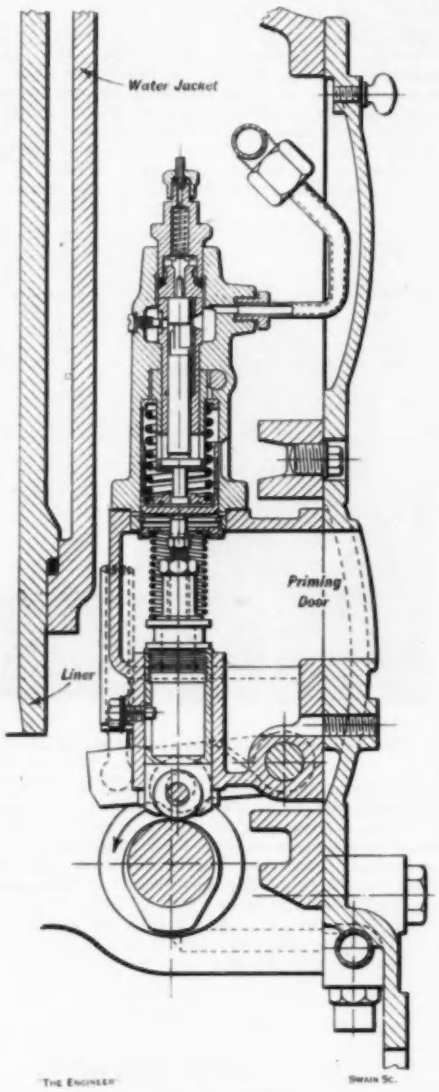

FIG. 3—FUEL PUMP AND DRIVE—ALLEN

and a one-piece design of cam shaft is used, the valves being operated by push-rods.

A useful provision is the charging valve on the cylinder head nearest the fly-wheel, which is released by screwing down the hand wheel shown. This operation also cuts off the fuel pump supplying oil to that particular cylinder, and allows it to act as an air compressor for providing the necessary starting air. The starting air is controlled by a small lever arranged at the end of the engine, which operates the distributor gear.

In Fig. 3 a section through the fuel pump and its drive is given. The pump itself is of standard design, and is directly operated from the cam shaft through a plunger. Provision is made for priming the pump and inspecting it under operation through openings formed in the casing. A close speed governor is fitted which regulates the quantity of oil delivered to the cylinders.

As will be seen from Fig. 4, all the engine controls, pressure gauges, fuel and lubricating oil filters, also a fuel heater are arranged at the end of the engine opposite to the fly-wheel. The filters are of the Zwicky dual type, and can be changed and cleaned while the engine is in operation. A lubricating oil cooler is also fitted. The lubricating oil pump is furnished with a "free wheel" device to enable the oil pressure system to be primed before starting up the engine. As will be seen from the drawing, the exhaust manifold is water cooled, and Negretti and Zambra exhaust pyrometers are arranged on each exhaust outlet. During recent extensive trials the following fuel consumptions for the engine we are describing were recorded:—Full load, 0·39 lb.; three-quarter load, 0·39 lb.; half load, 0·42 lb.; and quarter load, 0·54 lb. of oil per B.H.P. hour. A feature of some other trials which were carried out by Mr. W. A. Tookey, of Westminster, on a similar engine, was the low fuel consumption over a very wide range of load, with a high thermal efficiency and a capacity to sustain overloads over prolonged periods. The lubricating oil consumption of the new engine is about 0·0065 lb. per B.H.P. hour.

A second engine of the three-cylinder type with a designed output of 200 B.H.P. at 400 r.p.m., is also on view. The cylinders have a bore of 325 mm., with a stroke of 370 mm. This engine represents a series of two to six-cylinder units, with outputs of from 130 to 750 B.H.P. No examples of the larger air injection engine of the Allen-B. & W. type are shown, but they are manufactured in standard units from 130 to 1200 B.H.P., and are illustrated by

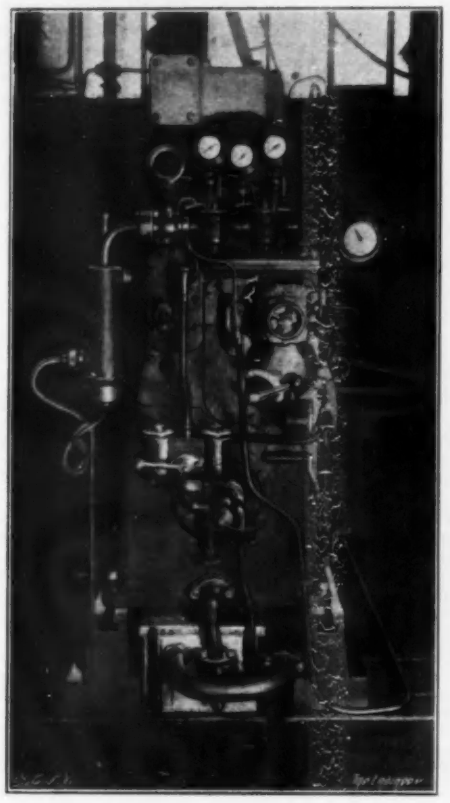

FIG. 4—END VIEW OF OIL ENGINE—ALLEN

photographs. Other exhibits include a 15 B.H.P., two-cylinder, 450 r.p.m., two-cycle engine, which is built in one to four-cylinder units, with outputs up to 200 B.H.P. Two Allen "Conqueror" pumps, arranged for belt drive, designed for high and low lifts, are also shown.

TANGYES LTD.

The largest exhibit on the stand of Tangyes Ltd., of Cornwall Works, Birmingham, is one of the firm's latest type twin-cylinder cold-starting oil engines, a view of which is reproduced in Fig. V. of to-day's Plate Supplement. The engine we illustrate is the smallest of a series of two-cylinder and four-cylinder units designed for industrial work or electric lighting service, with outputs of 144 up to 460 B.H.P. The cylinder diameter of the unit exhibited is 14½in., with a stroke of 21in., the rated output being 144 B.H.P. at 240 r.p.m. Our illustration shows the general appearance of the engine, which is characterised by its heavy bed-plate casting, of which the cylinder jackets form an integral part. The cylinder heads form a separate casting, in which the inlet and exhaust valves and the fuel atomiser are housed. The engine is started on compressed air, and for the purpose of replenishing the air starting receiver a combined charging and starting valve is provided. An interesting feature is the super-compression starter, a simple device which was fully described in our issue of February 22nd, 1929. The fuel pump is driven direct from the side shaft, and the quantity of oil actually delivered to the cylinders is regulated by the governor on the by-pass principle. A fuel heater and filter is provided, and close speed regulation is attained by a specially designed governor.

Another horizontal oil engine, also designed for working on various grades of fuel oil, is the 19 B.H.P. model, which has a cylinder bore of 7½in. with a 15in. stroke and a normal running speed of 325 r.p.m.

In Fig. 5 we show a new type of vertical fuel oil engine working on the two-stroke principle, which has recently been placed on the market by the firm. The engine is mounted on a deep bed-plate, so as to allow the two fly-wheels to clear the base. The cylinder crank case and jacket are formed in one piece with a separate cylinder head with the vaporiser. Starting is effected by a small heating lamp. The fuel pump is driven from the crank shaft and the amount of fuel delivered is varied by a simple form of crank shaft governor. Our illustration shows the 4 B.H.P. unit, which has a cylinder bore and stroke of 4½in., and runs at 600 r.p.m. A 6 horse-power unit

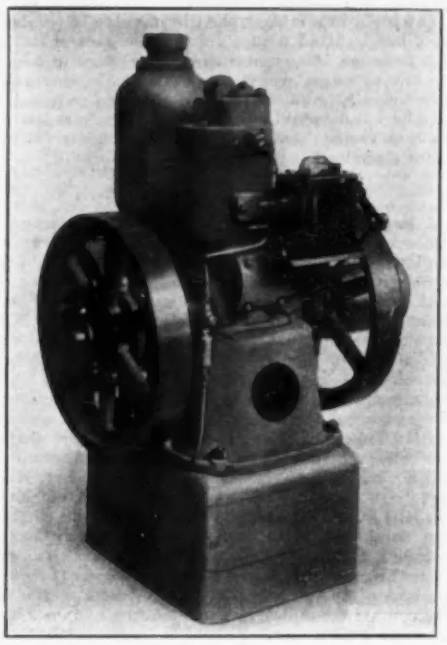

FIG. 5—4 B.H.P. FUEL-OIL ENGINE—TANGYES

of the same type with a 5½in. bore and stroke, running at 575 r.p.m., is also exhibited. Other exhibits include pumps and lifting tackle in which the firm specialises.

Another interesting exhibit is a new type of 120-ton hydraulic press shown in Fig. 6, which has been designed for the specialised work of moulding bakelite and other plastic materials. The press, as will be seen, is of the upward type, and is arranged with three "daylights" for multiple moulding. The plates, which are 17in. square, are made of

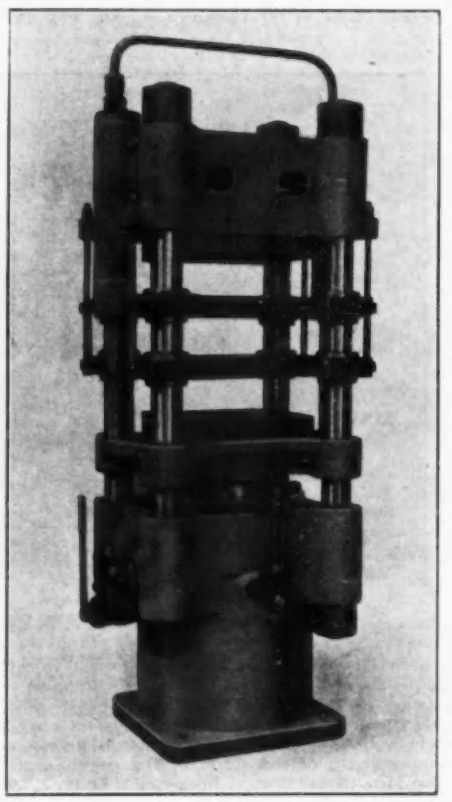

FIG. 6—120-TON MOULDING PRESS—TANGYES

forged steel, and are drilled from the solid and spaced for an even distribution of steam heat.

The cast iron cylinder crosshead is bored to receive the ram, which is fitted with a gland and is recessed for "U" packing. There are four mild steel columns, which tie the crosshead to the head of the press. Upon the ram there is mounted a cast iron platen, which is faced to received the lower hot plate, and is

fully guided around the columns. Insulation is provided between the head, the platen and the hot plates.

The press head, which is cast iron, is faced to receive the top hot plate and bored to take the columns. It will be seen that there are two push-back cylinders fitted to the head, and these serve to accelerate the return stroke of the platen and the main ram. The cylinders are of cast iron, with mild steel rams, and they are also fitted with "U" packings. They are operated at constant pressure.

The main ram is controlled by a valve of the lever type, but is fitted with an automatic control for the high pressure. One movement of the operator admits the low pressure, which, on reaching its maximum, automatically admits the high pressure required to complete the moulding process. These presses are made in various sizes, and can be fitted with steam, gas or electrically heated plates, as required.

BLACKSTONE AND CO., LTD.

A large range of oil engines specially designed to utilise heavy fuel oils, paraffin and petrol fuels, are displayed on the stand of Blackstone and Co., Ltd., of Stamford. It is of interest to learn that since the works were founded in 1896 no less than 25,000 Blackstone oil engines, aggregating about 350,000 B.H.P., have been supplied. The firm specialises in the horizontal type of engine with the Blackstone patented system of spring injection, a description of which has already been given in our columns. Engines of the horizontal type vary from the smallest units of 5 B.H.P. up to eight-cylinder engines of 1200 B.H.P.

The largest size ofsingle-cylinder engine is exhibited, and a view of this set is reproduced in Fig. II. in our Plate Supplement. It has a designed output of 150 B.H.P. The engine is larger than our illustration would seem to indicate, the overall length, including the heavy fly-wheel, being 16ft. 4in., with a total breadth of 13ft. and a height from the bottom of the base-plate to the top of the fly-wheel of 7ft. 4in. The same engine may be easily adapted to use either heavy fuel oil or gas. With the larger engines, fuel consumptions of 0·385 lb. of oil per B.H.P. hour are obtained. A feature of the spring injection system is the production of an initial pressure of about 550 lb. per square inch at full load, with a flat-topped indicator diagram. A mean effective pressure of 100 lb. per square inch is readily attained, and this, the makers claim, enables cylinders of small size for the brake horse-power developed to be employed.

In addition to the large engine, a series of smaller engines is also shown, including a 55 B.H.P. unit running light. There is also a 76 B.H.P. twin-cylinder engine—see Fig. 7—which is direct coupled to a generator and is exhibited running under full-load conditions for stand lighting. Several examples of small Blackstone engines, which have been designed for contractors' or farm use, are shown. Two of the

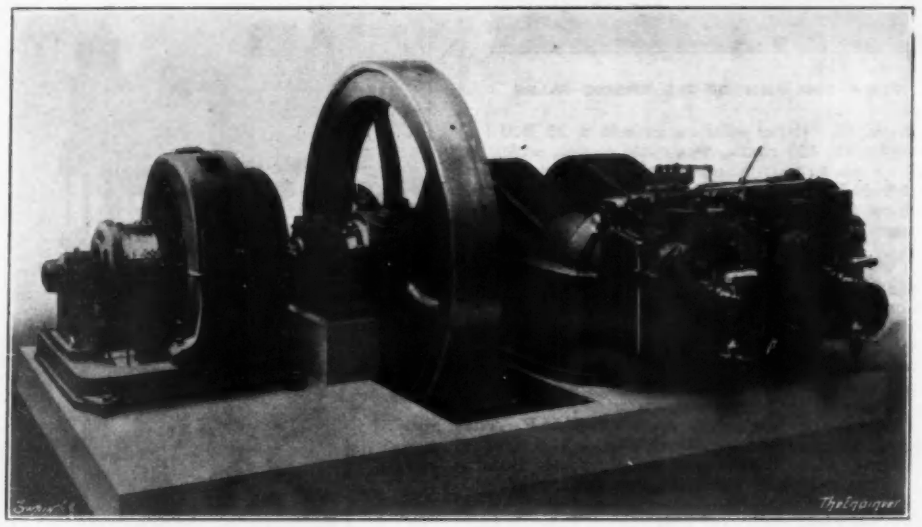

FIG. 7—76 B.H.P. TWIN-CYLINDER OIL ENGINE—BLACKSTONE

firm's new type of high-speed vertical spring injection engines are also exhibited. They have designed outputs of 40 B.H.P. and 60 B.H.P. respectively at 1000 r.p.m. The spring injection system on these engines has been designed to function correctly independently of the speed of the engine, and so enable the engine to start from cold. Other exhibits include "Unchokeable" pumps for handling sewage, storm water, gravel, &c., and other pumps and grinding mills.

BIRMINGHAM ELECTRIC FURNACES, LTD.

A full-scale section of a large "Birlec" furnace designed to show the robust method of construction and the patented heating element employed is one of the exhibits of Birmingham Electric Furnaces, Ltd., of 55, George-street, Parade, Birmingham. Owing to its size, it is impossible to show a furnace of this type in operation, but photographs illustrate furnaces for annealing and the general heat treatment of steel and non-ferrous metals and for bright annealing, carburising and hardening, &c. Two standard portable "Birlec" furnaces belonging to an entirely new range are being shown in operation. A model designated "H C P 2"—see Fig. 8—which is the smaller of the two, has a hearth 30in. long by 15in. wide, and a maximum rating of 18 kilowatts. This furnace is shown reheating steel parts previous to oil quenching. The larger model, which is designated "H C P 4 A" has a hearth 36in. long by 23in. wide, and a maximum rating of approximately 30 kilowatts. Whilst both models exhibited are similar in outward appearance to those shown by this firm at the British Industries Fair held last year, the heating

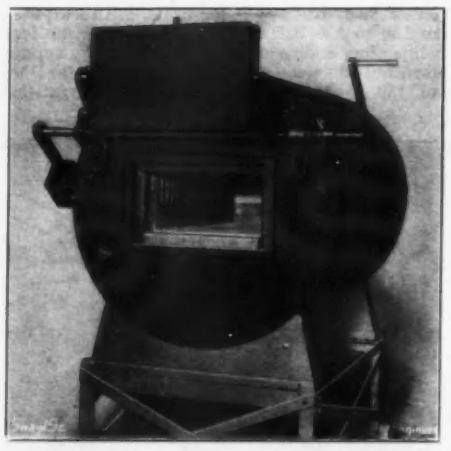

FIG. 8—PORTABLE ELECTRIC FURNACE—B.E.F.

elements are now similar to those employed in the firm's larger installations. This applies to all furnaces in the new series which incidentally does not supplant the previous series. The patented system consists of supporting the resistor, composed of heavy nickel-chromium strip, bent into zigzag form, on heavy gauge hooks made of the same metal. There is no contact between the element and the refractory, and all risks of hot spots owing to masking or of any interaction between the element and the lining are eliminated, and a very considerable increase in the life of the resistor, is said to result. The supports are placed at frequent intervals so that no sagging or distortion of the elements may occur. The furnace itself consists of a welded steel cylinder, which cannot easily be distorted or damaged, and apart from the hearth, which is flat, the interior of the furnace is also circular. The construction allows of free interchange of heat by radiation, so as to ensure even heating, and the heat is focussed on the centre of the charge, so that there is no tendency for the sides of the charge to be heated more rapidly than the middle. The heat insulation consists of Sil-o-cel, which varies in thickness from 4½in. to 9in. according to the size of the furnace and purpose for which it is to be used. The makers' patented parallel motion, insulated, socketed door, is easy to operate and tightly closed without clamping. It is lined with a refractory and insulation, which is covered with nickel-chromium sheet. The act of opening the door operates a switch which cuts off the current. Like the other electrical parts the switch is safely housed at the back of the furnace. All parts of the refractory which are subject to abrasion, such as the hearth and the edges of the door opening, are provided with nickel-chromium protection, the hearth being covered with heavy cast nickel-chromium plates while the side elements are well protected with cast nickel-chromium guards. Automatic temperature control apparatus, designed to maintain any desired temperature up to 1000 deg. Cent., is fitted to all models, as standard, and several types of this apparatus are exhibited, including an improved type of potentiometric recording controller. Another exhibit is a pot type furnace suitable for melting and holding metals such as aluminium, lead, babbitt, &c., or also salts. This model has a pot of internal dimensions of 17in. diameter and 17in. high and made of cast nickel-chromium alloy. For use with aluminium a cast iron or plumbago pot is used. The rating of this size of furnace is 24 kW. The heat insulation is exceptionally thick.

BULL MOTORS, LTD

The principal exhibits of Bull Motors, Ltd., are two electric generators. One is a slow-speed, compound-wound, direct-current machine for coupling to a Paxman oil engine, and has been built for use in the works of E. H. Bentall and Co., Ltd., of Maldon, Essex. It is designed for an output of 120 kilowatts at a pressure of 220 volts. The other generator—see Fig. 9, which shows the machine on the test bed—is a vertical spindle, compound-wound dynamo for coupling to a water turbine. The output is 52 kilowatts, and the pressure 220/260 volts. At the top of the machine there is a heavy spherical seated ball thrust bearing, designed to work under a continuous load of 4½ tons. Machines of this type

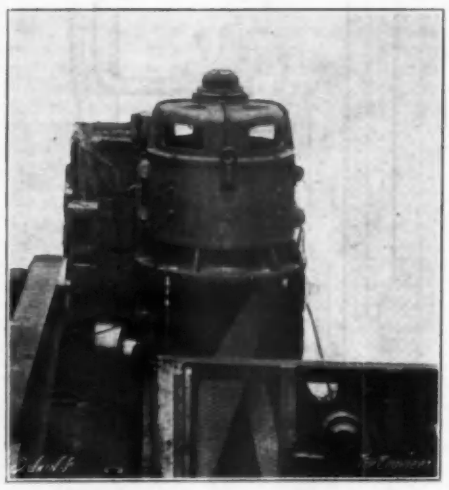

FIG. 9—VERTICAL-SPINDLE DYNAMO—BULL

can, of course, be used as vertical-spindle motors for pumping installations. Two arc welding equipments are shown in operation—a Bull portable "Midget" 100-ampère equipment, with all the control gear and the reactance mounted in a steel cubicle above the motor and welding dynamo, and a 200-ampère stationary welding plant, with a 200-volt motor, starter, regulators, and instruments, &c. A number of the firm's small alternating-current motors is also shown on this stand.

(To be continued.)

B.E.S.A. SPECIFICATIONS.

PLUGS AND SOCKETS.

A REVISION of British Standard Specification No. 196 has just been issued by the British Engineering Standards Association, and, although the differences between the new—1930—and the 1927 edition are small, they are of interest from the manufacturing point of view. One of these differences relates to the dimensions of the lug on the non-reversible plug and socket. It has been found that, with slight irregularities in manufacture, there was a risk in some cases of being able to force the lug—the non-reversible device—into a hole in the socket not intended for the reception of this lug. A slight modification to the dimensions has therefore been made in order to remove this possibility. A few other changes, mainly of an editorial nature, have been introduced, but from a technical point of view, the specification remains unaltered. Copies of the specification, No. 196—1930, may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, S.W. 1, and Stand 16 G 3, British Industries Fair, Birmingham, price 2s. 2d. post free.

THERE is a very striking reversion in New York to what used to be called the "house-to-house" system. Small transformers are going into buildings. The sizes used vary from about 35 kW to 300 kW single-phase. The distributing pressure is 14,000 volts. Three transformers are, of course, usually grouped together. A pressure of 27,000 volts would be preferred if small transformers at that pressure were good and cheap. In Brooklyn that higher figure is actually in use. As no more low-tension copper can be accommodated in the streets, all important new consumers must have transformers,

Railway and Road Matters.

DURING a dense fog on Monday evening last, a London, Midland and Scottish train from Glasgow to Coalburn was standing in Rutherglen station when it was run into in the rear by a train from Glasgow to Strathaven. Four passengers were seriously injured.

THE annual report of the Mersey Railway, which, by the courtesy of Mr. Joshua Shaw, has just reached us, shows that that company's passenger traffic continues to grow. The number of passengers increased from 13 millions in 1928 to 15 millions in 1929, and the receipts from £170,653 to £189,201.

THE Metropolitan Railway, according to its annual report, carried 96,941,278 passengers last year, which was an increase of nearly 206,000. The number of season tickets rose from 59,489 to 62,304. The report observes that passenger traffic to and from the outer suburban areas continues to expand and building in the districts served by the company's country lines is still increasing.

READING between the lines of the paragraph in this column on December 6th, it would be gathered that there was a suspicion that the fatal runaway of a Somerset and Dorset freight train when descending the severe gradient into Bath on November 20th was due to the enginemen having been overcome by gas fumes when passing through Coombe Down tunnel. The medical evidence given at the adjourned coroner's inquest on the 17th inst. and the statement made by the fireman in hospital showed that that was so. The jury returned a verdict accordingly.

ON page 488 of THE ENGINEER of May 3rd last we announced that Mr. A. P. Ross, the general manager and engineer of the Cheshire Lines Committee, was being removed to London to be the chief storekeeper to the London and North-Eastern Railway in place of Mr. G. F. Thurston, made general manager of the Southern area. In this column of our issue of October 18th we intimated that Mr. S. T. Burgoyne had succeeded Mr. Ross in his office of general manager, and it is now announced that Mr. K. C. Marrian is to follow Mr. Ross as engineer. Mr. Marrian has been Mr. Ross's indoor assistant since 1920 and was previously an assistant to the Derby district engineer of the Great Northern Railway.

As showing the public convenience afforded by a railway company's telegraph office being also a post office in the usual meaning of that term, it may be noted that, according to some figures given in the February issue of the *Southern Railway Magazine*, postage stamps, including stamps for 134,189 telegrams, to the value of £23,800, were sold last year at Victoria Station telegraph office, together with £12,840 worth of insurance stamps, 40,233 postal orders, 2904 money orders, and even 952 national savings certificates. Post office business was commenced on October 1st, 1911, and the following year the innovation was extended to London Bridge. Waterloo telegraph office began postal business on May 8th, 1922.

THE financial condition of the railways, as indicated by the dividends for the year 1929, must have been very much better than most people were led to expect. The Metropolitan started off with paying 4 per cent. for the year, which is the best result during the last ten years, except the British Empire Exhibition years of 1924 and 1925. The Great Western pays 7½ per cent., which, during the ten years, has only been bettered by the 8 per cent. of 1922 and 1923, and the London, Midland and Scottish declares a final dividend of 2½ per cent., making 4½ per cent. for the year, as compared with 3½ per cent. in 1928. It was generally understood that the Southern had had a bad year, but it has been able to raise its distribution for the year from 2 per cent. to 2½ and to carry £161,800 forward, as against £135,718. The Underground group makes the same dividend as a year ago.

IN *The Times* of February 13th was a letter criticising the procedure proposed in the Road Traffic Bill as to the hours on duty of the drivers of heavy motor vehicles. The letter in question does not comment on the limit laid down, which—clause 27—is ten hours in the twenty-four and five hours for a consecutive period of duty, but upon the procedure, in that, as the Bill is worded, every case of alleged contravention would have to be tried in Court. The correspondent suggests that returns should be made of time worked in excess of the stated period, as is done by the railway companies. In view of that suggestion we would say that the railway returns were an outcome of the Armagh railway disaster of June 12th, 1889. The Board of Trade, under the Act of 1889, which was a sequel to that accident, received powers which inspecting officers had long asked for. They were the concentration and interlocking of points and signals, the block system and automatic continuous brakes for passenger trains. Excessive hours on duty was another grievance. They were not made illegal, but all instances in excess of thirteen hours had to be reported. In 1893, however, the Board of Trade was given rather drastic powers which had a very good effect.

As related in this column on October 11th, there was, on the 4th of that month, a collision at Tottenham North Junction. Colonel Mount inquired into the accident, and his report thereon was issued on February 14th. There is a triangle at this point, the base of which is the main line of the London and North-Eastern and one side is the Tottenham and Hampstead line—which used to be owned jointly by the Midland and Great Eastern and is now London, Midland and Scottish and London and North-Eastern—and the other is a curve, belonging to the latter company, which runs from the Tottenham and Hampstead at the apex of the triangle at Tottenham West Junction to the London and North-Eastern main line at Tottenham South Junction. On the morning in question a goods train stood on the joint line at the North Junction when the driver thought he heard the signal lowered, so he applied steam and started. The signal was, however, undoubtedly at "danger," as the signal was "off" for an express on the down main line. Colonel Mount points out that automatic train control would have prevented the collision and recommends that facing safety points be provided in the line from the West Junction, as it is now solely used for freight traffic.

Notes and Memoranda.

THE results of some investigations into the corrosion of lead in buildings are summarised in a Building Research Bulletin, No. 6, recently issued by the Department of Scientific and Industrial Research. Particular attention is paid to methods for preventing possible decay of the metal when it is used in contact with cement or lime mortar or plaster, with timber or with soil. The Bulletin should be of considerable interest to architects, builders, and plumbers.

PORTUGAL has 354 electric power plants with a combined capacity of 135,722 kilowatts. The aggregate output of energy amounted in 1928 to 216,865,558 kilowatt-hours, as against 186,995,246 kilowatt-hours in the preceding year. The hydro-electric plants were responsible for 68,041,501 kilowatt-hours of the total—an advance of 24·31 per cent.—and the steam and internal combustion engine stations for 148,824,057 kilowatt-hours, an increase of 12·52 per cent., the gross output showing an increase of 15·97 per cent. over 1927.

AN insulating substance which changes into a conductor when circumstances demand it, was described by Karl B. McEachron, of the General Electric Company, at a meeting of the American Institute of Electrical Engineers on January 27th. Known as "Thyrite," the new compound functions as an insulator for ordinary low power purposes, being highly suitable for wireless aerials, but a sudden surge of high-voltage electricity, such as a stroke of lightning, instantly converts it into a conductor, thus providing a path of escape. In appearance "Thyrite" is stated to be a cross between black slate and porcelain.

AN interesting photograph of the first polyphase alternator installed in South Africa is published in the *South African Engineer and Electrical Review*. Three of these two-phase alternators were installed at the Sheba Gold Mine, near Barberton, in 1893. They were manufactured by Johnson and Phillips, Ltd., of Charlton, Kent. They were running until eighteen months ago, after nearly thirty-three years of continuous service, and in all probability would be running to-day if a fire had not broken out in the power station and completely destroyed the sets. Each of the machines was designed for parallel running, the output in each case being 132 kilowatts at 3300 volts between phases. These machines were installed to transmit power to the mine workings from the Queen's River by four underground cables over a distance of approximately 5 miles, after which a distribution network was arranged. Transformers were used to reduce the distribution pressure to 100 volts for the motor and lighting load.

A MESSAGE from Washington states that a cotton-fibre sorting machine for separating the fibres according to length, which gives promise of being more accurate and easier to operate than other available apparatus, is being made by Dr. R. W. Webb, cotton technologist of the United States Bureau of Agricultural Economics. The new apparatus, which has a series of combs and is a modification of several commercial machines of this type, is being made in connection with the Bureau's efforts to perfect methods of determining quality in cotton fibres as a basis for standardisation. Dr. Webb says that there is urgent need for more exact methods of measuring and describing quality in cotton, in view of the present definite efforts to graduate prices in close correspondence with quality. The factors of quality are involved by reasons of intricate biological relationships in the fibres and the fact that variations occur not only in different fibres but also within a single fibre as well as between the fibres emanating from the same seed.

IT is well known that the electron current from a hot wire can be increased enormously in certain circumstances by coating it with the oxide of an alkaline earth metal. Some investigations on these filaments are described by J. A. Becker, of the Bell Telephone Laboratories, in the second November number of the *Physical Review*. It appears probable that high activity is associated with absorption of the alkaline earth metal at the surface, and that many of the changes which occur in the emission are brought about by electrolysis of metal or oxygen atoms through the oxide, the value of the filament as a source of electrons as with composite filaments of tungsten and thorium or cæsium, depending on the fraction of the surface covered by the active metal. The efficiency of the latter is reduced if it is covered with oxygen atoms, but is increased if it is free on the side facing towards the vacuum, but anchored by oxygen atoms to the main surface. By appropriate control of temperature and electron current, either the alkaline earth metal or the oxygen can be made to evaporate. The probable process of electrolysis in the oxide is described, and it seems that Ohm's law is not valid; most of the current is carried by electrons, and a relatively small part by ions.

IN the *Journal* of the Franklin Institute for December, Messrs. P. H. Moon and A. S. Norcross show that in a solid dielectric there seem to be three different physical causes that lead to its disruption by electric stress. The experiments were made on the lead glass of the approximately spherical bulbs of flasks. Mercury inside the flask formed one electrode, and it was immersed in a bath of mercury which forms the other electrode. This arrangement gets rid of the edge effect. All the tests were made with direct-current voltage obtained either from a 100 kV kenotron set or a 4000-volt motor generator set. It was found, first, that for low temperatures and for low values of the thickness, the relation connecting the breakdown voltage with the thickness of the glass is a linear one. Secondly, for higher temperatures and greater thicknesses, the breakdown voltage is no longer independent of the temperature, but decreases as the temperature is raised. Finally, when the temperature is raised above 150 deg. Cent., the effect of temperature becomes much more pronounced and the region of thermal instability is reached, which has been much studied by electricians. Tests with sodium-lime glass give similar results. Apparently, there is no connection between resistivity and breakdown in the disruptive region. Messrs. Moon and Norcross consider that there are three distinct mechanisms of breakdown, the one that actually takes place depending on the temperature, thickness and constants of the material.

Miscellanea.

THE Cunard Company achieved another record last year by carrying more passengers across the North Atlantic than any other steamship line. This is the sixth year in succession in which the Cunard has attained this distinction.

DR. C. V. DRYSDALE, Director of Scientific Research under the Admiralty, has been appointed by the Secretary for Mines to be a member of the Explosives in Mines Research Committee, in the place of Dr. F. E. Smith, who has resigned on his appointment as Secretary to the Department of Scientific and Industrial Research.

IT is reported by the National Federation of Iron and Steel Manufacturers that the number of furnaces in blast at the end of January was 159, a net decrease of three since the beginning of the month. The production of pig iron in January amounted to 650,000 tons compared with 643,000 tons in December and 563,900 tons in January, 1929. The production includes 198,100 tons of hematite, 264,600 tons of basic and 159,900 tons of foundry and forge pig iron. The January production of steel ingots and castings amounted to 771,100 tons, compared with 661,200 tons in December, when the production was affected by the holiday period, and 764,600 tons in January, 1929.

"CHAINS and Other Lifting Appliances" is the subject of a Home Office Memorandum dealing with the causes of and possible means of preventing accidents which arise from the fracture or failure of chains and such lifting appliances as rings, hooks, shackles and swivels. It was originally published in 1915, and has now been re-issued after a thorough revision in which account has been taken of recent research work, more particularly that which has been carried out by the Department of Scientific and Industrial Research at the National Physical Laboratory in connection with the causes of failure of wrought iron chains and the effect of moderately low temperatures on such chains. The memorandum can be obtained from H.M. Stationery Office, price 2s.

WE are informed that the Council of the Iron and Steel Institute has this year decided to award Bessemer Gold Medals to two men distinguished in science and industry, namely, Dr. Walter Rosenhain, F.R.S., who has for many years held the position of Superintendent of the Metallurgy Department of the National Physical Laboratory, and whose work in the advancement of metallurgical science has received world-wide recognition, and Mr. Eugene Schneider, who owns the famous Schneider establishments at Creusot, France, and has, besides, extensive interests in the iron industries of Central Europe. It will also be remembered that Mr. Schneider held the office of President of the Institute in the years 1918–19, when it celebrated the fiftieth anniversary of its foundation. The President, Professor Henry Louis, will present these medals on the occasion of the annual meeting on May 1st.

THE Dominion Water Power and Reclamation Service of the Department of the Interior of Canada has issued its annual review of the water power resources of Canada developed and undeveloped as at January 15th, 1930. The total water power resources of the Dominion are now estimated to be 20,347,400 horse-power under conditions of ordinary minimum flow, or 33,617,200 horse-power ordinarily available six months of the year. The total hydraulic development at the present time is represented by a turbine installation of 5,727,162 horse-power, being an increase of about 378,000 horse-power during the past year. This bulletin contains estimates of the developed and undeveloped power in each province, and describes the use of power in the central station and pulp and paper industries, analyses the past and future growth in the utilisation of water power, capital invested in water power development, and the coal equivalent of developed water power.

IN a recent lecture before the Royal Aeronautical Society in the Hall of the Royal Society of Arts, Señor J. de la Cierva said he was satisfied it was possible to design autogiros having a top speed of 200 miles an hour. He could see no real objection to 3, 4, or 5-ton autogiros, though he believed more for the present in small and medium-sized machines. It was possible for an autogiro to be faster than an equivalent aeroplane. The autogiros lately produced had no better performance than the equivalent conventional aeroplanes. In fact, they had a little less speed and a little less climb. Nevertheless, they were better flying machines. If they still fell a little short of the best aeroplanes in that rather vague quality which was called "performance," they had a performance of their own, which was utility and safety. The top speed of existing autogiros, compared with several types of the best equivalent aeroplanes, was 5 to 10 per cent. less; the rate of climb 20 per cent. less; steepness of climb, 50 per cent. more; minimum horizontal speed, 50 per cent. less. The present-day autogiro could, with proper handling, be landed in perfectly still air with no run at all after touching the ground.

THE French Ministry of Public Works has authorised the Société de la Force et Lumière des Pyrenées to undertake the electrification of the Artigues waterfall on the Adour le Garet, and the equipment of a hydro-electric station. A reservoir will be formed by means of a barrage 11 m. high at an altitude of 2035 m., and will provide about 250,000 cubic metres of water per day through a subterranean canal 2076 m. long. The station will be placed at an altitude of 1203 m., and at the outset it will have a capacity of 9000 kW. Permission has also been granted to the Société de Transport d'Energie Electrique de l'Est for the creation and exploitation of a transmission line between Graffenstaden (Bas Rhin) and Logelbach (Haut Rhin), and between Graffenstaden and the thermal station at Port du Rhin. A further concession authorises the Société Algerienne d'Eclairage et de Force to construct and exploit distribution lines, substations, and transformers, but not to generate electricity, which will be supplied by a station now being constructed at Alger. La Société Est Electrique has obtained a concession to establish and to operate a distributing system, substations and transformers in La Meuse and the Ardennes. Electricity will be supplied from an outside source at three-phase, 5000, 15,000 and 45,000 volts.

THE POLISH PORT OF GDYNIA ON THE BALTIC SEA

(For description see page 207.)

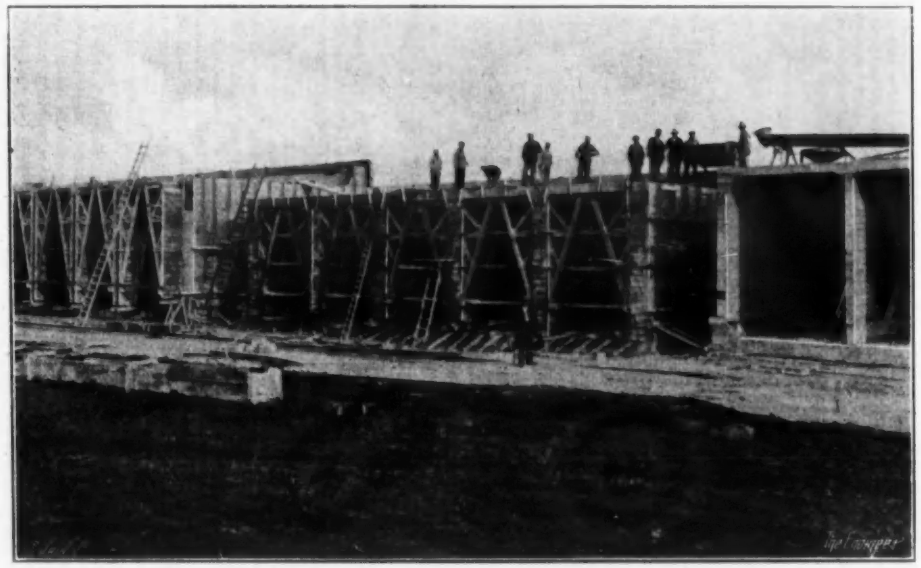

FIG. 12—SERIES OF QUAY WALL CAISSONS UNDER CONSTRUCTION

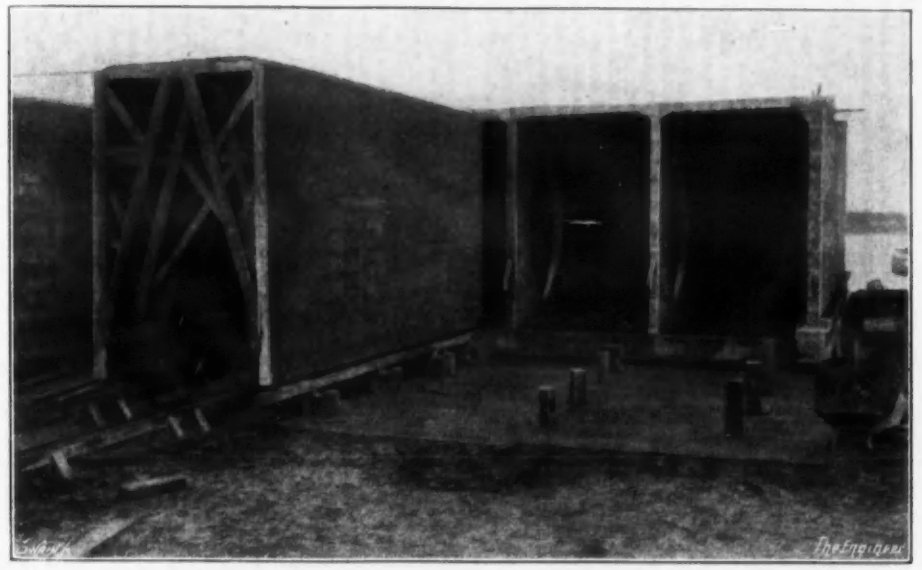

FIG. 13—CAISSON FORM COLLAPSED AND MOVED SIDEWAYS AFTER CASTING

FIG. 14—BUILDING UP QUAY WALL ON CAISSONS

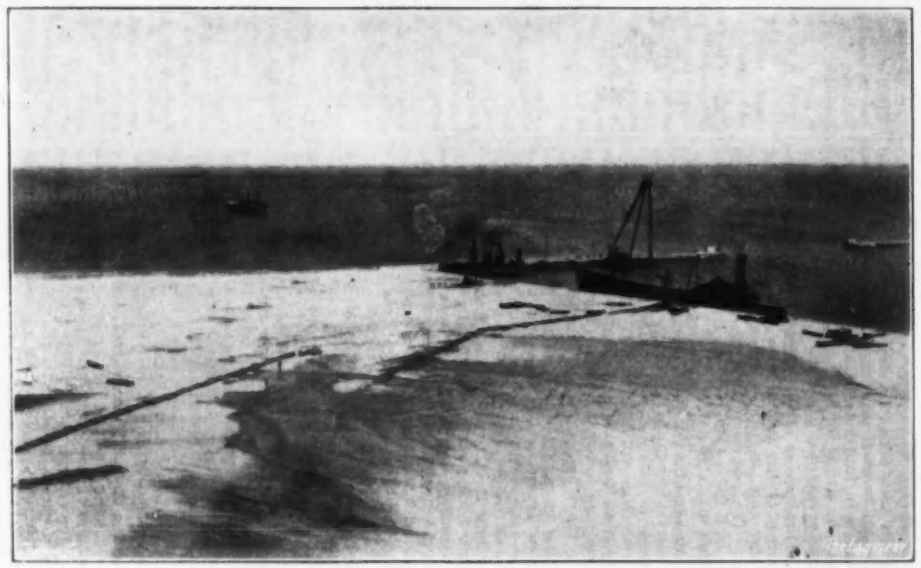

FIG. 15—DREDGER PUMPING SAND INTO SPACE BEHIND QUAY WALL

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THE ENGINEER.

FEBRUARY 21, 1930.

Continental Steel Cartel.

AT the time when the Continental steel trade began to feel its way, soon after the Armistice, and when there were many who saw that the future had changed with the changing conditions of production, proposals came from Germany which, in the light of after events, proved to be prophetic. They urged the creation of a Steel Cartel which could alone save the Continental industry from disaster. They perhaps overstepped the mark by suggesting that such an organisation was necessary in order to meet the competition that was expected from the United States. It was only when, a few years later, the steel trade touched the lowest depths of depression and disaster seemed imminent, that the French steelmakers started negotiations with the Germans, and the Steel Cartel was ultimately formed, although on a much more restricted basis than that proposed by German firms. These wanted to limit output and establish a sales organisation for export price control. They always argued that an attempt to limit production alone would prove ineffective. The Steel Cartel, as constituted, aimed solely at a reduction of output, and for the time being it had the effect of lifting the steel trade out of the slough of depression and of giving to it a certain stability which enabled the industry to carry on under satisfactory conditions. This improvement coincided with an increased consumption and in consequence the limitation of output became less rigid, there being, in fact, a continual increase of production in nearly all the countries concerned. The only gain was the moral effect of an official limitation, and the undertaking of each country not to compete for business in associated countries. As a set-off, competition in other markets became still more severe, and when home requirements declined, the price cutting abroad left the steel trade in a situation that threatened another period of disaster unless something was done at once to make the operations of the Steel Cartel more effective. This is where the Germans have again scored with their principle of an export trade control. They have long declared that they would withdraw from the Cartel unless that principle were put into practice. The French have now accepted it, and preliminary negotiations are so far advanced that the Cartel appears likely to be renewed on an extended basis at the meeting to be held in Paris next month, subject to the Germans and Belgians obtaining satisfaction over the question of quotas.

So urgent is this question of price control that a temporary arrangement has been come to pending the settlement of the conditions under which the Cartel will be renewed. It is expected that the international sales comptoir, under the control of the Cartel, will be created within six months' time, and meanwhile the temporary comptoirs, which may be regarded as practically formed, decided in Brussels last week to raise export prices 4s. a ton for plates, 2s. 6d. for merchant bars, and 2s. a ton for semi-manufactured steel. The increased price for strips has not yet been fixed. It is not proposed to increase officially the prices of other products, as they will advance automatically. Rails are, of course, already regulated by the International Union. Until the details of the final comptoir are settled, probably when the Cartel is renewed, it is impossible to know exactly under what conditions it will operate. Although the limitation of output may remain officially in force it will have no real effect upon the situation, unless it be a moral one, for experience has shown that it cannot be enforced, even with the threat of penalties, and it is understood that the Cartel has decided to forego the penalties already incurred by nearly all the countries concerned. It is believed that the only way to restrict production is to control the export trade. France, Germany, Belgium, Luxemburg and the Saar will each have their quotas of export business, and in each country the orders will be distributed according to the respective capacities of manufacturers. In the event of any country exceeding its quota, penalties will be strictly enforced. As a matter of fact, it is difficult to see how any country can do more than its share of the business. Under the temporary arrangement each manufacturer is required to communicate to the comptoir a statement of the orders received and the prices at which they are taken, and the comptoir is at liberty to do what is necessary to ensure a fair distribution of the work amongst all the producers. This is already being done in the wagon-building and some other industries. A similar international arrangement has been entered into by the steel tube firms. The principle of maintaining prices on a profit-making basis, and of distributing the business amongst firms according to their capacity to produce, is making headway, and is the basis of the new organisation in the steel trade. It has yet to be seen whether the permanent comptoir will continue the present arrangement of centralising orders received by manufacturers or whether it will become itself the commercial distributor. There are many difficult points to be settled before the comptoir can be definitely established.

It is obvious that if the permanent comptoir works upon the lines generally indicated, the production will be necessarily adjusted to requirements, and manufacturers will lose their individuality, since consumers will no longer know by whom the goods supplied to them are produced. Whether that is desirable, time will show. The only thing that interests British manufacturers is the effect that the new continental arrangement is likely to have upon the competition for foreign trade. It is significant that when discussing this matter, people abroad regard it as, in a sense, a measure of protection against competition from Great Britain and the United States. The production of steel by the five countries belonging to the Cartel in 1929 was 32,977,000 tons, representing an increase of 5,000,000 tons on the preceding year, despite the policy of restriction, and the steel production in Great Britain and the United States was 63,818,000 tons. Therefore, the Continental combination is avowedly a concentration of interests with a view to resist especially the threatened increasing American competition. So far, this stage is being reached without apparently any defined policy as to future operations. This may be shaped by events. For the moment it is hoped that a powerful Continental combination alone will keep the home market intact, possibly with the help of a more liberal measure of fiscal protection, but it is difficult to see how the comptoir, under the ægis of the Cartel, can secure foreign trade without modifying its policy of minimum prices. At present that policy is inevitable, because production costs have increased to a point

at which the late prices for export left no profit at all. Much of the business has been done at a loss. Apparently, therefore, the Cartel hopes to exclude foreign steel from the home markets, and once that is done the comptoir will have its hands free to compete for foreign trade. The comptoir will exercise entire control over the export business and will eventually be able to accept orders at the lowest prices at which makers will consent to execute them, the profits being secured mainly upon the protected trade in the home markets. That this is possible is shown by the attitude of consumers in France, who fear that the effect of the new combination will be to increase prices still further. The only check to such an operation will be a corresponding decline in consumption, so that there is obviously a limit to what the comptoir can do. For the moment the situation is vague, because a definite policy has not yet been formulated, and while much is said about the organisation of the export trade for the benefit of Continental steel makers, the only result at present is an increase of prices which has been necessitated by the growing burdens on the steel trade.

The Jet-wave Rectifier.

WHATEVER the general opinion concerning the merits of the jet-wave rectifier may be, few will fail to appreciate that it is an exceptionally ingenious piece of apparatus. While mercury plays an essential part in its operation, the principle differs widely from that of rectifiers that depend for their action on the non-return valve property of the mercury vapour arc. The paper read by Professor Jul Hartmann before the Institution of Electrical Engineers on Thursday of last week, and published in abstract on another page of this issue, shows clearly that there is little resemblance between the mercury arc rectifier and the author's invention. The jet-wave rectifier belongs to the mechanical class, but whereas other rectifiers of that kind involve the use of commutators or other solid metallic moving parts, such as vibrating reeds, the switching operations are carried out in the jet-wave apparatus by means of a wave-shaped mercury conductor, which makes alternate connection at proper intervals with two electrodes connected to the ends of a secondary winding of a transformer tapped at the mid-point. Thus the wave jet acts as a switch, and ensures that a circuit connected with the jet and the mid point of the transformer receives direct current. This simple arrangement naturally applies to the rectification of single-phase current, but as will readily be understood, the rectification of multi-phase voltages presents no difficulty. The rectifier that has been almost exclusively produced is the six-phase type, which consists of three mercury jet commutators connected to the three secondary phases of a three-phase transformer, and the three two-phase rectifiers thus formed are connected in series.

The method of producing the mercury wave jet is simple and easy to understand. A mercury jet passes through a constant field, and through that part of the jet which at any moment is located within the field an alternating current is passed, with the result that the interaction between the field and the alternating current causes the jet to form itself into a wave which advances half a wave length during a half period of the alternating current. By interposing electrodes in the path of this moving conductor in the manner shown in the paper, the jet-wave may be used for the commutation of any alternating voltage in phase with the current by which the wave is produced. The method which the author employs of cutting the jet bridging the two electrodes by means of tungsten knives and of absorbing the energy of the spark by means of hydrogen will be clear from the paper, which indicates that the development of this rectifier has been very far from a simple and straightforward job. One of the most difficult problems seems to have been that of finding a satisfactory method of tapping the jet-wave, but the problem has been solved by using a curry-comb electrode consisting of two cylindrical pieces of steel, on the surfaces of which a series of equidistant ribs with sharp edges are turned, or a sharp thread is cut. Between these two curry-combs the mercury jet wave passes and the ribs cut a few tenths of a millimetre into it. With this arrangement the jet-wave is unimpaired, whilst currents of several hundred ampères can be handled. A real idea of the difficulties Professor Hartmann has had to face can, however, only be gathered from a study of the paper in its entirety. Had the mercury vapour rectifier never been invented, this relatively new piece of apparatus would have had no serious competitor, but as it is, it remains to be shown what advantages it can offer over the mercury vapour type of rectifier. Up to the present the jet-wave rectifier has only been built for outputs up to 200 or 300 kilowatts and for voltages of 220 and 500, which, of course, are small compared with the outputs and pressures of some of the metal-cased mercury vapour rectifiers. The author sees no reason, however, why outputs and pressures should not be increased; in fact, he goes so far as to say that a 100-kV rectifier could be produced by connecting 100 simple jet-wave commutators in series. The possibility of converting direct current into alternating current is another of the author's suggestions.

No very definite figure is given concerning the cost, although it is believed that it will compare favourably with that of other rectifying equipments. Nor is any reference made to floor space. The most expensive material employed in the construction of the jet-wave rectifier is the mercury. For large rectifiers the amount necessary at present is 0·5 kilo. per kilowatt, but a reduction in that quantity is anticipated, and the substitution of some other metal or alloy of low melting point is considered to be within the range of possibility. The rectifier does not, of course, work entirely without moving parts. The mercury pump must operate all the time, and in certain cases it is necessary to provide a small generator for the supply of current to the direct-current magnet. On the other hand, the rectifiers that have been built do not require to be air or water-cooled. The efficiency at light loads does not appear to be maintained as it is with mercury vapour rectifiers, but falls off very much in the same way as that of converting machines. In dealing with short circuits, the apparatus has apparently proved itself to be satisfactory. As the paper shows, short circuits that have put rotary converters out of operation have merely caused these rectifiers to work at greatly reduced voltage, whilst after the removal of the short circuit normal operation has been restored. While opinions may differ concerning the prospects which this type of equipment has before it, few will deny that its development has called for great skill. To have built a rectifier working on this jet-wave principle is an accomplishment of no mean order, and the fact that it has taken fifteen years to produce indicates how patient and persevering the inventor has been.

The World Engineering Congress in Japan.

(By Our Special Representative.)

No. X.*

VISITS (*continued*).

IN conclusion of what I have already said about Kobe* may I now add that one thing which will do much to facilitate traffic in Kobe is the completion of the overhead railway now in course of construction. It will carry the Government Railway trunk line over the whole length of the city, and, unlike the similar construction in Tokio, is being built of reinforced concrete. It will be the most conspicuous improvement ever effected in the city's communications, disposing of numerous level crossings, which, with the extraordinary growth of population, have become each year increasingly inconvenient to street traffic and a growing menace to public safety.

NAGOYA.

Another city which has undergone what may without exaggeration be described as phenomenal development is Nagoya, generally referred to as the capital of Central Japan. The Great War "made" Nagoya. Before that era it was a quiet inland city —remarkable chiefly for its striking castle—carrying on a small pottery and textile industry which supplied domestic requirements. In 1908 the trade of Nagoya was valued at less than Yen 2,500,000, imports and exports; in 1928 this trade was valued at Yen 133,000,000. Its population has more than doubled since the fateful year 1914.

The chief exports of Nagoya are porcelain, earthenware, cloisonné, and cotton textiles; the chief imports are ginned cotton, wool, and timber, most of which leaves the country in the form of manufactured goods. A big trade is done also in clocks, glassware, and packing cases—the latter important in connection with the extraordinary trade carried on in curios, which include the genuine and the counterfeit (scarabs, found in the sands of Egypt, are made in Kioto; those wonderful old Chinese bronzes so much admired at home, worn thin with generations of usage, are likewise products of the Japanese craftsman's skill, coming from Sado Island, in the Japan Sea—*cf.* Sir Edmund Hornby's Autobiography, lately published).

While the late war is primarily responsible for Nagoya's present-day prosperity, the opening of the railway communicating with the industrial interior to the west, the products of which formerly reached their ports of shipment overseas *vid* Tokio or Osaka, greatly increased Nagoya's importance as a distributing centre; and what has practically converted an inland city into a seaport is the conversion of the ancient fishing town of Atsuta, 5 miles away, into the port of Nagoya. Modern harbour works have been completed, and the metropolis of Central Japan thus given a maritime status, for the ships of the great Japanese companies now call regularly, bringing cotton from Bombay and conveying the products of Nagoya factories to the ports of the Middle and the Near East and the African coast. Nagoya is the third largest city in Japan in population and second in area. The population is now nearly one million.

KIOTO.

One does not, as a rule, associate industry with the ancient capital, celebrated for its temples and general artistic beauty, but it has always been and remains to-day the centre of what is commonly called the "fine arts" industry; in other words, it is the stronghold of the craftsman, and the artist in craftsmanship. Here are made the beautiful embroideries that foreigners of all ages and sexes rush to see, after settling down in the hotel, and whose prices appal even millionaires. No one understands the psychology of the buyer better than the modern Japanese craftsman or salesman, who has never heard of the Manchester School. Intoxicated at being asked five thousand yen for a few yards of something, the delicate workmanship of which requires a microscope to see, the overweighted lady from Spokane, Wash., fascinated by the general display, pays five hundred for something that is worth fifty. Trade in Kioto is a very aristocratic occupation, engaged in by men and women whose ancestors of a remote generation created the business and the family name and wealth, supplying the luxurious needs in earlier times of the Court nobles, who had little else to do but attend to their personal needs, they, like the Emperor, surrendering the actual government of the country to the more vigorous warlike clans which carried on continuous warfare, very much as is the case to-day in China. Kioto became a synonym for luxury and refinement, and so still remains in the mind of the Japanese; and so it actually is, as the centre of production of things that are beautiful.

But it has other claims to distinction in this industrial age. The first electric tram was tested in this city; and here, curiously enough, the first electric heaters were demonstrated, the distinguished audience on the occasion being princes and nobles attending the enthronement of the late Emperor Taisho in 1915. Here also is one of the model mills of the great Kanegafuchi concern, which every foreign tourist visits as a matter of course in the sightseeing programme.

A work of no little engineering interest is the canal which connects the city with Lake Biwa, some 6 miles to the north-east. This work was completed in 1890, having been begun in 1885. Its length is about 6½ miles, and there are three tunnels, one attaining a length of 1½ miles. The total drop below the lake level is 143ft. A branch canal designed to provide electric power was completed in 1912. The following details of the waterway and its engineer are taken from Murray's "Guide to Japan."

"An interesting work is the Lake Biwa Canal, which, with the Kamogawa Canal, the Kamo River itself, and the Yodo River, has brought Lake Biwa into navigable communication with Osaka Bay. It was opened to traffic in 1890, and supplies water power to mills and factories in Kioto. The main canal is 6¾ miles in length, and in parts of its course runs through tunnels. The total fall is 143ft., and at Ke-age, near its entrance into Kioto, the greater part of this fall is utilised for traffic by means of an incline one-third of a mile in length, along which the boats, placed in wheeled cradles, are drawn by an electric motor stationed at the foot of the incline. At Ke-age, at the top of the incline, the water of the canal divides, one part flowing in a branch canal 5½ miles long, which runs north of Kioto and is available only for irrigation and water-power. The other part is conveyed in parts to the foot of the incline, where, before again forming a navigable canal, it serves to give the power needed to work the electric motor which, by means of a wire cable, runs the boats up and down the incline. From the foot of the incline there is another stretch of open canal, with a regulating lock between it and the old canal leading to Fushimi. But this old canal being able to pass only boats of small draught, is of little use; and a new one has been made to Sumizone at Fushimi. This, the Kamogawa Canal, already mentioned, has eight locks and one incline, and carries heavy cargo and passenger boats.

"A curious personal item in connection with the matter is the fact that the design of such a waterway, which should also be suited for the transport of men and merchandise, was made the subject of a graduation thesis for the diploma of the College of Engineering in Tokio by a student who then became the engineer entrusted with the execution of the work. His name

* No. IX. appeared February 14th.
† See THE ENGINEER, February 7th.

is Tanabe Sakuro. Having lost the use of the fingers of his right hand, all the writing and drawings for his essay were done with the left hand."

It is interesting to know that the advantage of such a canal was realised as early as the twelfth century, when, according to the guide to Kioto furnished to the W.E.C. delegates, Taira-no-Kiyomori actually had the plan of such a canal drafted. Again, during the Tempoera (1830–43), surveys were made, showing that the idea of a canal had long been in the Japanese mind.

The manufactures of Kioto are valued at something less than Yen 150,000,000 annually, consisting of silk and cotton fabrics, embroidery, pottery, cloisonné, lacquer and damascene ware, and fans and dolls. In the Middle Ages, of course, the swordsmith was supreme, but his is to-day a lost art.

TOKIO.

Several cities in Japan are, in area, larger than the capital. Among them are Osaka, Nagoya, and Yokohama, all of which have recently extended their boundaries by taking in adjoining populous areas which were practically parts of the respective cities. This fact constitutes one additional reason for the expansion of the capital, which is only some 37 square miles in area, against Yokohama's 57. A more important reason is the fact of the enormous exodus of population since the earthquake—some hundreds of thousands who found it impossible to return, and have consequently made their homes in suburbia, to the detriment of the city's revenue and traffic.

For generations Tokio was simply a consuming centre, manufacturing little or nothing. It was the home for six months of the year of tens of thousands of idle samurai, retainers of the daimyo of the provinces, whom an astute Shogun compelled to spend six months of the year in the capital, and who during the remaining six months left their wives as hostages and as a guarantee of their good behaviour. But during the past quarter century the city has developed as a manufacturing centre in a remarkable degree, so that it is now referred to as the chief industrial centre—an observation which makes Osaka furious.

There is some basis for the assertion. The region on the other side of the river, Tokio's East End, is an area devoted to factories—all practically forced into existence by war—the Russo-Japanese War and, to a much greater extent, the late war, which the Japanese call the European war. Japanese factory industry has been wholly created by war.

According to the guide to Tokio prepared for the W.E.C. delegates, the number of factories in the city is 6438 and the workers 203,930. What is meant by "factory" is not stated; the figures, however, give an average of about 32 employees. I believe such statistics are based upon factories employing a minimum of five workers, thus excluding the innumerable "home industries" that are to be seen all over the city and are not confined to any particular quarter. On the commercial side the companies registered in the city number 3957, with a subscribed capital of Yen 5,870,807,000, which gives the large average capitalisation of a million and a-half. Tokio—Japan—is notorious among foreigners for heavy capitalisation of banks and companies and for its handling of large sums in a commercial way. The head of the largest spinning company in the country has just retired, and has received a "retiring allowance" of three million yen; the retiring allowance is one of the peculiar features of Japanese industry and finance. To discharge a man when his services are not needed is only the beginning of trouble for the Japanese employer, and when "hands" are dismissed in multiples, often running into the hundreds and thousands, the problem of the retiring allowance assumes ominous dimensions, particularly when there is little or nothing in the treasury. How they manage it remains a puzzle to the foreign newcomer until he begins to look with understanding at a new world.

Tokio's most striking industrial developments in recent years are concerned with machinery; everything electrical is manufactured. The people show a real aptitude for this class of industry, which is in every way a recent growth, but a very intensive one. The electrical industry began on a large scale with Americans supplying part capital and skill, until the Japanese were able to take up the manufacture of American patents. They now do so, and exploit patents of their own. All sorts of machinery are being turned out, and the day of the motor car and motor cycle is not far off. It is only a question of time.

The new harbour is another feature of the city deserving notice, because of the fact that the regulations forbid the building of steam plants with their smoke and chimneys—everything electrical operates here. There is wisdom in this, for while the country has coal that is poor and dear, it has an abundance of electrical power and will make pre-eminent use of it.

As pointed out in the guide referred to, the harbour scheme dates back to 1885. Tentative plans, often debated, assumed definite shape in 1920, and the earthquake, rather than retarding the scheme, advanced it and proved the strongest ally of its advocates. It is not to be expected that the harbour will ever berth Pacific liners, but Tokio is the centre of a great domestic trade, and communication with Yokohama was very largely by lighter. In rough weather the passage was always attended by great loss of lighters and goods, to obviate which was one of the reasons for starting harbour construction. When the harbour is completed the services of Yokohama will be dispensed with, but by that time it is considered there will be plenty of prosperity for both.

The calamity of 1923, in some ways, was a blessing in disguise for the capital of the empire. It opened the way, which could have been provided in no other manner, for rebuilding, widening and straightening narrow and crooked streets, removing, it is to be hoped, acres of fœtid alleys, the homes of the poor, one and two-storeyed wooden houses, periodically destroyed by fire and always a terrible menace. A great effort has been made to rebuild with consideration for the health and happiness of the inhabitants. It is true that much of the picturesque is being sacrificed in the process. In the main streets some very dignified native buildings are to be seen, but they look insignificant next the huge eight-storey monster that daily takes in and disgorges ten thousand human beings. But Tokio is resigned to the prospect; it is no longer Japanese—it is a city of the world, and the citizens take pride in the fact. Ten years hence it will be a mixture of Paris and New York, and the curious tourist will have to hunt in neglected quarters for the evidences of Dai Nippon.

Obituary.

A. A. CAMPBELL SWINTON.

IT is with the greatest regret that we learn of the death of Mr. Alan Archibald Campbell Swinton, which took place on Wednesday, February 19th, at his home in Chester-square. At the time of his death Mr. Swinton was only sixty-six years of age, but his career was distinguished by success as a consulting engineer and by his scientific researches in radiology and wireless development work. He was born on October 18th, 1863, and was educated both in Edinburgh and abroad. From 1882 to 1887 he spent his time at Armstrong's Elswick Works, after which he came to London and began business as a consulting electrical engineer. At the same time he was interested in telephones, and was connected with a supply company, which, we believe, ceased business on account of Post Office objections. He was also engaged upon the administrative side of electricity undertakings, and the manufacture of electrical machinery, and in the latter capacity he was chairman of Crompton and Co., Ltd., and the subsequent firm of Crompton-Parkinson and Co., Ltd., while he was also connected with several electricity supply undertakings. Along with Sir Charles Parsons, Mr. Swinton was closely associated with the development of the steam turbine for land and marine services.

Alongside his business activities, Mr. Swinton carried on an important series of scientific experiments. He was a pioneer experimenter with X-rays, and at an early date indicated the possibility of distant electric vision, foreshadowing the later developments in that field. In 1914 he invented a new method of recording signals by means of a sensitive manometric flame, which was caused to move by sounds emitted from a telephone receiver, the movements being recorded on a moving strip of sensitised paper. He was an early user of the wireless telephone, with which his Victoria-street office and his house in Chester-square was equipped.

Mr. Campbell Swinton was a valued member of the Institution of Civil Engineers, the Institution of Mechanical Engineers, and the Institution of Electrical Engineers, and was a Fellow of the Royal Society. In 1911 he was elected Chairman of the Röntgen Society, and two years later he was made Chairman of the Radio Society of Great Britain. He was also a Chairman of the Council of the Royal Society of Arts on two occasions, and was a member of the General Board of the National Physical Laboratory.

M. B. FIELD.

THE firm of Kelvin, Bottomley and Baird, Ltd., of Glasgow and London, has suffered a severe loss in the death of its managing director, Mr. Michael Birt Field. Mr. Field was knocked down by a motor car on Friday evening, February 14th, and died the following day in the Royal Glasgow Infirmary. He was a London man, and his connection with Glasgow began in 1900, when he was appointed electrical engineer to the Glasgow Corporation Tramways Department. Later he became chief engineer of the undertaking, which was then under the management of Mr. John Young. After a long period of service with the Tramways Department, Mr. Field left Glasgow to take up an appointment with Ferranti Ltd., at Hollinwood. He returned, however, to Glasgow in 1912 to assume the duties of managing director of Kelvin, Bottomley and Baird, Ltd., a position which he held with distinction. The services of Mr. Field during the war in the manufacture of navigational and electrical instruments for the Government were duly recognised by the authorities. He was a member of the Institution of Civil Engineers and the Institution of Electrical Engineers, and was prominently associated with the work of the latter Institution in Glasgow. The death of Mr. Field is the second loss by accident which the firm of Kelvin, Bottomley and Baird has sustained within the last three years. It will be recalled that another late member of the firm, Mr. Alfred W. Baird, was drowned in the river Tay in January, 1928, when stepping off the tanker "British Faith," after completing the compass trials of that ship.

Literature.

Motor Vehicles and Tractors. By P. M. HELDT. London: Iliffe and Sons, Ltd. 40s.

THIS volume was written to take the place of Vol. II. of the "Gasoline Automobile," four editions of which were published, and the reason for the alteration of title is that the scope of the work has been changed. In the former volume both design and production methods were dealt with, whereas in the volume under review the author has confined himself to design only. More attention is given to heavy commercial vehicles and agricultural tractors. The same general division of the material has been retained, while new chapters have been introduced on subjects that have recently come into prominence. The principles of toothed gearing, for instance, are dealt with extensively, and there are chapters on the front wheel drive, the four-wheel drive and six-wheeled vehicles.

Some idea of the ground covered by the book will be gathered from the fact that there are in all twenty-four chapters and an appendix. The work is intended as a text-book in automobile engineering and for reference purposes in designing new products connected with the self-propelled vehicle, and it seems singular that almost every essential component is dealt with except the motor itself. The reason for this, presumably, is that the same author has written a volume on engines. It would, therefore, appear that the title of the present work is misleading and that a better name would be "Motor Vehicle Transmission Systems."

The chapter on friction clutches deals fairly exhaustively with all the principal varieties, single and multiple disc, and those with either direct or inverted conical friction surfaces. The type now most popular is the single-plate dry type, the clutch being combined with the fly-wheel which forms one of its members. The single-plate clutch is made in a number of different types according to the method of engagement and disengagement. In some cases there is a single spring, and in others a series of coiled springs and levers is employed to press the frictional surfaces together. In the latter type some care is required to keep the levers properly adjusted, otherwise the disengagement of the clutch is liable to be faulty and gear changing is rendered difficult. The cone clutch, which was once the most generally fitted, is now rarely used, except in the cases of one or two light cars which employ the inverted cone.

The chapters on toothed gearing and change-speed gears form a very complete treatise on this section of motor car construction, and the author describes a number of interesting change-speed systems which are unfamiliar in this country and which will repay the reader for careful study. The chapter on change gear mechanism would have been more complete if the interesting new gear-box which is now being introduced by Armstrong-Siddeley Motors on their most powerful cars had been described. This is of the epicyclic type. A small amount of space is devoted to free-wheel, or "over-running" clutches, and the author gives a brief description of one well-known form which was recently introduced in Great Britain.

There are chapters on bevel-driven rear axles, worm drives and double-reduction axles, all of which appear to be "up to date." The chapter on brakes is one of particular interest on account of the lucid descriptions of the different types of servo mechanism, termed by the author boosters.

The book is well printed and the illustrations are very satisfactorily reproduced from drawings.

BOOKS RECEIVED.

The List of Members of the Institute of Metals. London: The Institute of Metals, 36, Victoria-street, S.W. 1. Price 2s. 6d. net.

Steam and Gas Engineering. By T. E. Butterfield. London: Macmillan and Co., Ltd., St. Martin's-street, W.C. Price 18s. net.

The "Ironmonger" Diary and Hardware Buyers' Guide, 1930. London: Morgan Brothers (Publishers), Ltd., 42, Cannon-street, E.C. 4.

Pickling of Iron and Steel. By W. G. Imhoff. London: The Penton Publishing Company, Ltd., Caxton House, S.W. 1. Price 25s. net.

Calvert's Mechanics Almanack, 1930. Edited by John Brooks. London: John Heywood, Ltd., 20, St. Bride-street, E.C. 4. Price 6d. net.

Weetman Pearson, First Viscount Cowdray, 1856–1927. By J. A. Spender. London: Cassell and Co., Ltd., La Belle Sauvage, E.C. 4. Price 21s. net.

The Economics of the Coal Industry. By R. C. Smart, M.C., M.I. Min. E. London: P. S. King and Son, Ltd., 14, Great Smith-street, S.W. 1. Price 12s. 6d. net.

The South and East African Year Book and Guide, 1930. Edited annually by A. Samler Brown and G. Gordon Brown. London: Sampson Low, Marston and Co., Ltd., 100, Southwark-street, S.E. 1. Price 2s. 6d. net.

Practical Aspects of Spark Testing.*

By WALTER G. HILDORF and C. H. McCOLLAM.†

EITHER an outline of its history or a bibliography extending as far back as space will permit is often the inevitable introduction to a technical subject. In the case of spark testing such an introduction is necessarily brief, as up to quite recently there has been very little written on the subject. Probably the earliest reference is that quoted by Brearly in "The Heat Treatment of Tool Steel," wherein a French metallurgist, writing in 1804, comments on the variation in sparks from different steels. As a matter of fact, up to more or less recent times there was little or no practical use for such methods as spark testing. Tonnages were much lower, there were comparatively few grades of steel, and time was not such an important factor. Under the circumstances it is hardly surprising that the interest in the possibilities of spark testing was largely academic.

During recent years there has been a decided change. A large number of steels of different analyses have come into existence, tonnages have increased enormously, and time has become a matter of vital importance. As a result considerable interest has developed in cheap or rapid methods of segregating steel of different composition, as a measure of protection to the user.

It is hardly necessary to go into detail as to what happens when foreign steel does get mixed into an order, except to say that the results are very apt to be unfortunate. Protective measures are particularly important in the case of mills producing many different alloys on a quantity basis; it is practically impossible to devise a production system that is absolutely fool-proof. At the plant of the Timken Steel and Tube Company, spark testing seemed to afford a great many possibilities as a method of checking steel,

Characteristic Spark from a 0·15 Per Cent Carbon Steel.
The bursts are quite simple.

and therefore considerable work has been done to develop it as a practical process.

Before considering what has been accomplished, a brief discussion of the scope and limitations of the method may be of interest. Spark testing, from a practical standpoint, is a method of sorting different grades of steel according to the form of spark thrown off when they are ground. When applied with care to the sorting of certain definite classes of steel, it offers a reliable, fast, cheap and adaptable means of classification.

It is not, however, a test of the quality of the steel, for it will not detect laps, cracks or seams, nor will it determine hardness or grain size. It should not be used, as it sometimes is, for identification of steels selected at random. Its value lies in the fact that once two kinds of steel, whether in billets, bars, or tubes, or even in machined parts, have been mixed, it is almost impossible to tell from outward appearance which is which. The spark test may be applied to the sorting of steels so mixed, or it may be used as a safeguard against possible mix-ups of this sort. It is in the latter capacity that it has found its greatest usefulness in the Timken plant.

Spark testing has numerous advantages over other methods of sorting, although it does not always replace such methods. For example, while chemical analysis is an absolutely definite method of sorting, it is only practicable where a small number of pieces of large individual mass are concerned. Such cases would be largely restricted to ingots, large forgings, or blooms. Where it is a matter of smaller pieces, especially in the case of machined parts, even if it were possible to take samples from the individual pieces, the analysis would probably cost more than the parts were worth.

Hardness tests, such as Brinell, Rockwell, and scleroscope, require somewhat more time than spark testing, and, where steels have the same carbon content, are practically worthless. Fracture determination is positive, as two steels will seldom show the same fracture, but the fractured piece has to be scrapped, which limits the practical value of the test. The use of the spectroscope requires as much technique as spark testing, and the instrument is much more expensive and is not conveniently portable.

The basic theory on which spark testing is founded is sound chemistry and physics. When steel is held on a grinding wheel small particles of the metal are torn loose, and if the tearing is sufficiently violent the temperature of the particles rises considerably. This is a matter of physics—temperature rise in accordance with work done. As the hot particles fly through the air at high speed they come in contact with a great deal of

Characteristic Spark from a 0·30 Per Cent Carbon Steel.
The bursts are more intense and there are small secondary bursts.

oxygen. As a result, as the individual particle proceeds, its iron is oxidised, becoming iron oxide.

Our theory is that if there is carbon content it combines with the oxygen to form carbon dioxide gas at a rate faster than that at which the iron oxide is formed. Since the carbon dioxide gas occupies greater volume than the original carbon, and the iron is soft and plastic at the high temperature reached, the carbon dioxide will escape into the surrounding air, carrying with it minute particles of iron.

In other words, there will be a series of secondary sparks. As the percentage of carbon increases the number and intensity of the bursts becomes greater, until with

Characteristic Spark from a 0·45 Per Cent Carbon Steel.
Both the frequency and intensity of primary and secondary bursts are greatly increased.

1 per cent. carbon steel they are distinct explosions. Or, as the proportion of carbon increases, the proportion of CO_2 gas to the weight of the metal increases, and the ability of the gas to throw small particles of metal off at a tangent to the spark line becomes greater.

The sparks given in the first four illustrations show how the size and intensity of the bursts increase with a growing percentage of carbon. As a further confirmation of the theory, microscopic examination of the cooled particle will show small craters produced presumably by the escape of the CO_2.

In modern practice carbon is only one of several elements that may be present in a given steel, so that the carbon spark alone is not a trustworthy basis for sorting. In fact, it may frequently happen that the tester will be called upon to sort two steels of the same carbon content, but differing with respect to the other alloys included. Fortunately, most of these alloys either have characteristic effects of their own, or their presence has an effect on the carbon bursts that is easily recognisable.

As an example, the nickel-molybdenum spark given below shows several marked peculiarities. The spear point at the end is always found when molybdenum is present, and the slight swelling in the carrier line near its beginning is characteristic of nickel. Actually this swelling is a spot of intensely white light, easily noted against the characteristic orange colour of the normal carrier line. Nickel also has an inhibiting effect on carbon bursts, their absence, or comparative weakness, being another indication of its presence. The other alloys, chromium, manganese, &c., also have certain characteristic effects.

In ordinary practice the entire shower of sparks thrown from the wheel, or what is termed the "spark picture," is carefully examined. The whole picture is divided into three equal areas: the portion nearest the wheel, that in the middle, and that farthest from the wheel. Each is examined individually for salient features. These features, which are the variables upon which recognition is based, may be divided into three groups: (*a*) carrier lines, (*b*) spark bursts, and (*c*) characteristic sparks.

As to the first, the carrier lines, which are the glowing streaks left by the iron particles, form the background of the spark picture. They may vary in length, breadth, colour, and number of lines per picture. Spark bursts are found throughout the length of the carrier line. They will vary in number, size, intensity, shape, and distance

Characteristic Spark from a 1·00 Per Cent Carbon Steel.
The primary bursts resemble small explosions and the secondary ones show even further or tertiary bursts.

from wheel to first burst, or from last burst to tail spark. The matter of characteristic sparks has already been discussed.

TRAINING A SPARK TESTER.

The first thing the tester must learn is to concentrate on one area of the picture at a time. Next he must learn to watch only those sparks that cross his line of vision, or to keep his eyes fixed on a certain point and "catch" the sparks as they pass that point. Thus he will form a mental picture that gradually becomes clearer until he notes the details of the bursts, which he can visualise after they have died out. He confirms this mental picture again and again until he has definitely classified the spark with a known standard.

For practice with beginners it is better to start with two steels of known analysis, preferably with widely differing carbon content, and no alloys present. After an operator has had sufficient experience with different sparks he will soon develop the speed and confidence necessary to sort a great many different kinds of steel. It is a help to accurate work if he can be taught some of the reasons for spark variations. If he has some conception of these principles, he will be better equipped to detect variations among steels of somewhat similar characteristics.

If spark testing is to be accorded proper recognition it must be absolutely infallible on any job to which it is applied. This means that the *personnel* must be well trained, but it also means that spark testers cannot be selected at random. It is well known that only a certain percentage of the men found in the average employment office are capable of development into steel inspectors. By the same token, not every inspector can be taught spark testing. The first requisite is, of course, good eyesight, but in addition the eyes must be "light-sensitive." The distinguishing of sparks is a matter of differences in the light rays thrown off, and it is frequently very fine variations that identify types of steel. Furthermore, there is no room on a spark testing crew for men inclined to haphazard work.

If steel is to be sorted, it must be thoroughly sorted; every foreign piece must be taken out. The man who is apt to become careless after checking thousands of pieces in a day without finding a bad one simply does not belong on a spark testing crew. On the other hand, the one piece of steel of different analysis that comes up after a thousand pieces of O.K. stock will stand out like a red

* Reprinted from the *Iron Age*, October 10th, 1929.

† Metallurgical engineer and chief chemist, respectively, of the Timken Steel and Tube Company, Canton, Ohio.

flag to the properly trained spark tester. It is not uncommon for a spark tester working on small pieces in lots of a thousand to be four or five pieces beyond a bad one before he can stop. His muscular reactions become so automatic that they cannot be changed for several seconds, nevertheless the picture of that one foreign spark will register so clearly that there is no hesitation in sorting it out.

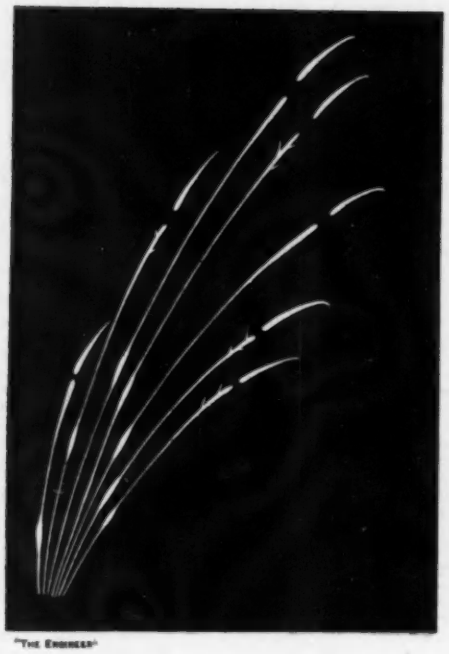
Equipment which is Necessary.

Once spark testing had been settled upon a practical basis at the Timken plant, the matter of equipment came in for considerable attention. The grinder which was selected as standard is the Dumore No. 1 JG grinder with 1½ by ⅜ by ¼ 46-S wheels. The grinder complete weighs about 5 lb. and has a shaft speed of 15,000 r.p.m., giving it a peripheral speed of about 5000 r.p.m.

The grinders have been specially adapted for the work by the Commercial Tool Company by the addition of an aluminium handle parallel to the shaft. The handle is equipped with a push button switch for controlling the motor. Ball type oilers are used, since lubrication is an important factor. The whole is light and readily portable, being suitable for work on tables, and light enough to be used for testing steel in racks at some distance from the ground. The small wheel running at high speed gives a very satisfactory spark shower without removing an appreciable amount of stock. In fact, it sometimes requires close examination of the piece to find the place where the grinder was applied.

Another factor taken into consideration was the protection of the operators' eyes. The wearing of glasses to ward off small particles of metal and emery is, of course, a basic safety precaution. But in this case there is another factor to be considered, protection from constant subjection to injurious light rays. Dr. E. J. Fieman, the plant physician, has supplied two types of glasses for this purpose. One is the ordinary light blue glass used in hospitals, while the other is a special glass, known as "Soft-lite," in the darkest shade—a very light rose tint.

It was first thought that the work could best be carried



Characteristic Spark from Nickel-Molybdenum Steel.

on in a dark room, but it was soon discovered that such conditions actually induced eye-strain, probably because of the intensity of the light rays in the absence of other light. The work is now done in a little more than half light, the sparks being thrown in shadow wherever possible. It is also good practice to use a black tarpaulin, spread on the floor, as a background for the sparks.

In conclusion, it might be said that spark testing has saved thousands of dollars in various industrial plants. A record of the work done at the Timken plant, or in other plants by men trained in the Timken plant, would show close to a million pieces sparked. At the present time there are over a dozen spark testers regularly assigned to the Canton plant of the Timken Steel and Tube Company, and at the company's Wooster and Gambrinus plants. Every tube made at these plants is checked by spark testers during its final inspection, as a precaution to prevent the shipment of mixed lots of steel.

The reason for using the test on tubes and not on bar stock is that there are many more mill operations on the former, and it is correspondingly harder to keep them from getting mixed. If any question arises as to mixed steel in lots of bar stock, it is checked by spark testing before shipment. The value of the check on both tubes and bar stock is proved by the almost total lack of complaints arising from shipments of mixed steel to users.

The annual Tramways Returns—which correspond to the Railway Returns—for the year ended December 31st, 1928, for companies, and March 31st, 1929, for local authorities, have been issued as a Stationery Office publication, price 10s. 6d. They show, when compared with the previous twelve months, a decrease of 2·47 per cent. in the gross receipts and of 2·11 per cent. in expenditure. Passenger journeys were fewer by 1·75 per cent. and car-miles by 0·07 per cent.

The Jet-wave Rectifier.*

The principle and the constructional development of the jet-wave rectifier have already been described in previous papers, and it is therefore thought to be unnecessary to discuss them in detail in the present paper. It may not, however, prove inappropriate to compare briefly the entirely new principle of the jet-wave commutator—the main constituent of the jet-wave rectifier—with the well-known principles of mechanical synchronous commutation. This is done in Fig. 1, in which *a* represents

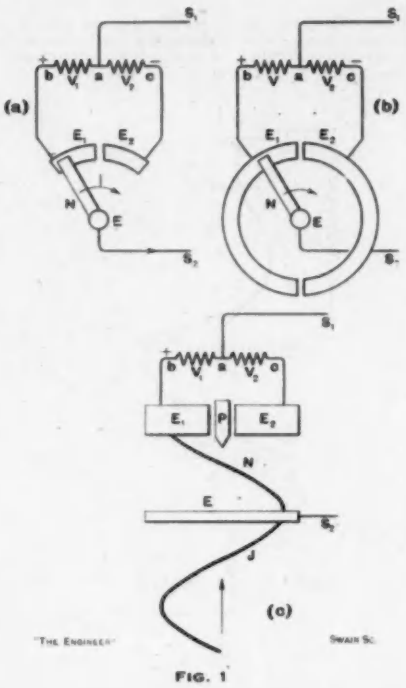


FIG. 1

the well-known oscillatory principle and *b* the rotary principle. The principle of the new commutator may be termed the translatory principle, its moving member being a wave-shaped conductor J which travels with constant velocity, disappearing into the electrodes E_1 and E_2 and alternately connecting the two sides of the same with a special tapping electrode E. It is explained in the papers referred to how the wave-shaped conductor may be produced from a mercury jet through interaction between a constant field F—Fig. 2—and an auxiliary alternating current supplied by an auxiliary transformer V_A. It is highly essential for the proper understanding of the *modus operandi* of the commutator to note that the jet-wave produced moves on as a whole with the velocity *v* of the original jet, each particle of the wave following a straight line through the centre of the field. If the wave is to be used for the rectification of an alternating voltage as indicated in Fig. 2, it must advance half

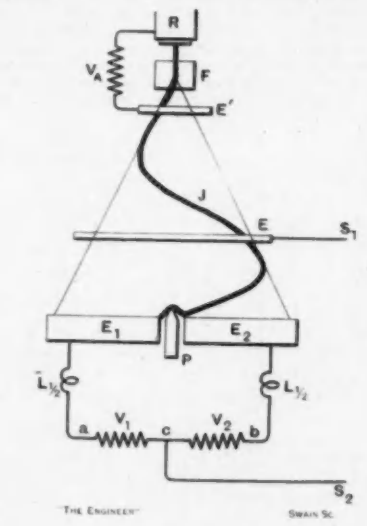


FIG. 2

a wavelength—½λ—during half a period—½T—of the alternating voltage. This is achieved by utilising a current synchronous with the voltage to be rectified for producing the wave. Furthermore, the cutting of the wave by the knife P should be effected at a definite point in the voltage wave, generally at the zero-point of the voltage. This may be brought about by adjusting the distance from the field to the electrode E_1E_2. The feature which makes the wave principle superior to the oscillatory and rotary principles—see Fig. 1, *a* and *b*—is the absolutely stiff coupling between the voltage to be rectified and the motion which effects the rectification, *i.e.*, the motion of the "hitting-point" of the wave in E_1E_2.

Rectification of multi-phase voltages may be effected in several ways by means of jet-wave commutators of the type shown in Fig. 2, or by other similar commutators. The rectifier which has so far been almost exclusively produced and studied is the six-phase series type, which simply consists of three commutators similar to that in Fig. 2 connected to the three secondary phases of a three-phase transformer, the three two-phase rectifiers thus formed being connected in series. The resulting rectified voltage exhibits the ordinary six ripples per period, and the direct current component is approximately 0·95 E_0, E_0 being the maximum value of the phase voltage of the transformer secondary.

The Jet.

As the position of the main electrode, E_1E_2 in Fig. 2, depends on the velocity of the jet, this velocity must be kept constant within very fine limits, say, within a few tenths of 1 per cent. The jet is, therefore, produced by means of a reservoir and a jet pipe, the level of the mercury in the former being kept constant by means of an overflow. The maintenance of the jet naturally requires a hydrodynamic circuit with a pump.

The Magnet and the Magnet Loss.

The jet wave is now almost always produced by means of a constant field in interaction with a synchronous alternating current passed through the jet, as indicated in Fig. 2. For the production of this field an electro-magnet is generally employed, the coils of which are kept outside the chamber in which commutation takes place, the limbs being carried through the top of the chamber and insulated from the top plate. The current for the excitation of the magnet is generally taken from a current direct source, if available; otherwise, the magnet is fed from a small direct current generator which may be coupled to the axis of the alternating current motor operating the pump. With the coils taken outside the commutation chamber the latter need no longer contain any material which may be attacked by mercury, *e.g.*, copper, or damaged by heat, *e.g.*, cotton. Hence, a considerable temperature can be tolerated in the chamber, say, 100 deg. Cent., or more, and artificial cooling of the chamber may, in many cases, be avoided. With a chamber of ordinary cast iron the intensity of the magnet field is reduced considerably by straying of the magnetic flux to the top plate. The latter, or, alternatively, the whole chamber, should, therefore, be produced from non-magnetic cast iron. It may be noted that magnets with coils enclosed

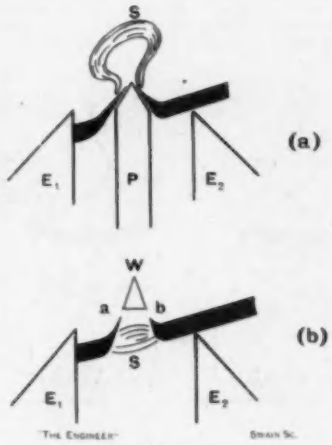


FIG. 3

in air-tight boxes of non-magnetic cast iron may be mounted wholly inside the chamber. The construction is, however, objectionable on account of the poor cooling of the coils. A good many types of magnets other than that indicated above have been tested.

The Main Electrode: the "Wearless" and the Stabilised Commutator.

With the jet-wave commutator, commutation is accompanied by a transient arc. The latter originates from the stray fields of the transformer, the effect of these fields being in the main the same as that of two self-inductances $L_{\frac{1}{2}}$, inserted as indicated in Fig. 2. When the supply of the rectified current I_d is changed from, say, the left-hand to the right-hand side of the transformer, the energy stored in the left-hand inductance must be made to disappear while an equivalent amount of energy must be produced in the right-hand inductance. The commutation spark is the direct consequence of this process, and has an important effect on the economical working of the jet-wave rectifier in as much as the electric energy which is transformed into heat in the spark generally represents the largest loss in the rectifier plant. On the other hand, the spark has given rise to one of the main problems in the constructional development of the main electrode in that the latter, and especially the cutting device, must be capable of withstanding the corroding effect of the commutation spark. It had hitherto been considered almost impossible to solve this problem: nevertheless a complete and simple solution has been found.

The solution consists in replacing the insulating wall P, indicated in Figs. 2 and 3 (*a*), by a knife W of conducting material, and preferably of high melting point—Fig. 3 (*b*). A tungsten knife is generally employed. While with a cutting device like that of Fig. 3 (*a*), the spark occurs at the edge of the insulating wall, and so impairs the latter more or less, the spark with the tungsten knife almost always remains between the cut ends of the jet wave. It therefore only evaporates mercury which is presently again condensed in other parts of the system. With an ordinary high-power commutator for, say, 30 kW, the height of the knife may be 5 mm. and the width of its base about 3 mm. Such a knife will withstand the normal spark power, which may amount to 1 kW or 1·5 kW, for practically any length of time, and so a

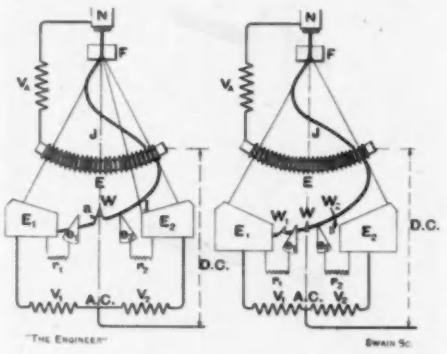
* Abstract of paper read by Professor Jul Hartmann before the Institution of Electrical Engineers.

"wearless" commutator for mechanical rectification has been brought into existence.

Immediately the cutting of the jet-wave is completed two sparks are undoubtedly formed at *a* and *b*. These sparks, however, unite almost instantly into one single spark, as indicated in Fig. 3 (*b*). It has been found that if the normal spark of a large power commutator is in some way or other forced to bridge over to the tungsten knife, then the latter is almost immediately destroyed by melting. On the other hand, it has been proved that with regular operation of the knife the latter will handle overloads of 50 or 100 per cent. for considerable periods, and that it is not impaired by direct short-circuiting of the commutator.

With normal commutation the knife must be adjusted to such a position relatively to the two sides of the main electrode that these sides are short-circuited for a short time—the "interval of metallic short-circuiting," or the "overlapping interval"—during each commutation. Otherwise, the circuit of the rectified current is obviously broken and a greatly increased spark loss ensues, especially if the circuit contains self-inductance. During the overlapping interval a short-circuit current i_c will generally grow up in the transformer, and this current will add to the normal rectified current I_d, thereby increasing the energy stored in the stray field and, hence, in the commutation spark. It will thus be gathered that for economical reasons it is essential to reduce i_c to as small a value as possible. Generally, this is achieved by reducing the interval of overlapping, but, on the other hand, this interval must not be made too small, for then the inevitable uncertainty of the process of cutting may too frequently change the overlapping into an interruption, with the effect of a heavy increase in the spark loss, especially at greater loads. Generally, however, the overlapping interval may be taken as low as 2 to 3 per cent. of the half-period of the alternating voltage to be rectified. But even with such small values of the interval it has proved necessary, or advantageous, with large-capacity commutators to provide special means for reducing the short-circuiting current i_c. In this way the so-called "complex electrode" was introduced.

Fig. 4 represents such an electrode. Each of the two electrode sides now consists of two pieces, the main pieces, E_1, E_2, and the secondary electrodes, e_1, e_2. Between the two members of each side the electrode resistances r_1, r_2 are inserted. At the instant depicted in the figure the left-hand resistance r_1 is short-circuited by part of the jet wave connecting E_1 and e_1, while the right-hand resistance r_2 is inserted in the short-circuiting circuit of the transformer, reducing the current i_c. It will be noted that no new idea is involved in the device here



FIGS. 4 AND 5

considered, which obviously is based on a well-known principle from cell-switch practice.

In addition to the means here considered for controlling the short-circuiting current, it has been found useful with large-capacity plants to add to the effective self-inductance of the transformer. This is done by inserting suitable coils in one—or in both—of the connections between the transformer and the main electrode, as indicated by L_1, L_1, in Fig. 2.

If commutation with a mechanical rectifier has not been brought to an end—that is to say, if the spark has not vanished—before a certain moment, the normal commutation spark is changed into a permanent arc, which, during the next half-period, or even longer, completely short-circuits the transformer, generally throwing the rectifier out of action. The explanation of this instability is as follows:—The spark lasts for a certain interval, which generally extends beyond the zero point of the voltage to be commutated. This does not matter provided the voltage of the transformer has not, at the end of the interval, risen beyond a certain limit. If, however, this limit is passed, the voltage may be sufficient to produce a new discharge in the opposite direction in continuation of the orginal spark. This new discharge will be acted upon by an increasing voltage and will, therefore, develop into a permanent arc. This phenomenon of instability greatly endangered the development of large-capacity rectifiers until perfect stability was ensured by the simple stabilising device indicated in Fig. 5. The commutator here shown is much the same as that in Fig. 4, the only difference being that two tungsten knives, W_1, W_2, have been inserted between the secondary electrodes e_1, e_2, and the main parts E_1, E_2. During the commutation indicated in the figure the knife W_1 will cut the wave nearly at the same moment as the main knife W, thereby inserting the resistance r_1 in series with the spark created at W. If this spark should tend to change into an arc the tendency is checked by the resistance r_1.

MANIFOLD CUTTING: PARALLEL AND SERIES AGGREGATES.

During recent investigations the explanation of the *modus operandi* of the stabilised electrode in Fig. 5 was doubted. For if the jet wave is cut by, say, the knife W_1 before the spark below W is extinguished—and such are generally the conditions—a spark appears below W_1, short circuiting the resistance r_1. Possibly, therefore, the resistance is not alone responsible for the increase of stability, or is not even of any great importance. This doubt gave rise to an experiment which led to a new and simpler main electrode, which is shown in Fig. 6. Here the secondary electrodes and the resistances are dispensed with, and are replaced by a series of tungsten knives, introducing manifold cutting. With three symmetrically arranged knives, simultaneous cutting by two knives may be obtained, and it at once proved that a stability equal to that of the electrode in Fig. 5 is achieved. With a five-knife electrode—Fig. 6—the wave is cut simultaneously by three knives; and with an electrode of this description in a 33·3-kW, 180-volt commutator, the stability was increased. Obviously, the arrangement of spark gaps in series affords a simple and most effective means of stabilising the commutation process. Recognition of this fact is likely to lead to results of great consequence. In the first instance it is evident that the higher stability opens up the possibility of producing commutators for higher voltages, *e.g.*, for 500 or even 1000 volts. For the

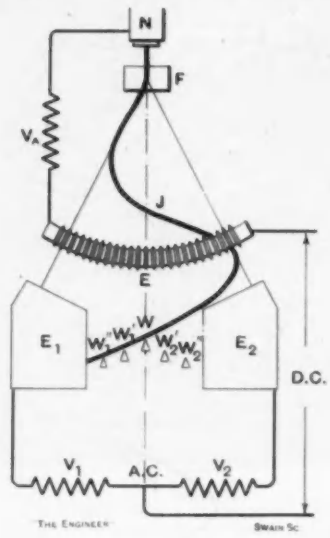
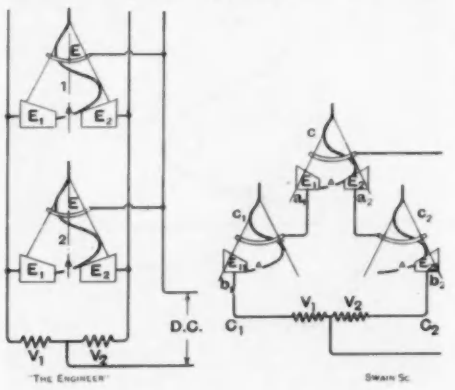


FIG. 6

present three and five-knife electrodes are used co-ordinately with the older electrode of Fig. 5 in high-capacity commutators for voltages up to 180.

In order to commutate larger currents or powers than can be handled by a single commutator, two or more commutators may be operated in parallel in the simple way indicated by Fig. 7. It should be understood that the jets of such aggregates may be fed from a joint reservoir, but each jet must as a rule have its own jet pipe. Furthermore, the fields may be produced by means of a single magnet. With suitable design of the joint members the aggregate assumes the character of a unit commutator, the capacity of which may be raised to several hundred kilowatts. It has proved feasible to produce simple commutators which have two jet waves instead of one playing on a single main electrode of ordinary design.

Again, several commutators may be connected in series for the commutation of extra-high voltages. The principle is illustrated in Fig. 8. It will be noted that during every alternate half-period the rectified current is carried by C_1 and C through E_{11} and E_1, while during the remaining half-period the same current passes through C_2 and C, *viâ* E_{22} and E_2. Obviously, any number of commutators like C_1 may be inserted in series in the branch b_1 a_1, and it is seen that all the spark gaps of the series-connected commutators are in series during the commutation. More-



FIGS. 7 AND 8

over, as the principle of manifold cutting may be used in each of the several commutators, the possibility of commutating extremely high voltages by means of aggregates like that of Fig. 8 is evident.

THE AUXILIARY ELECTRODES.

The electrodes E′ and E—Fig. 2—used for the introduction of the auxiliary current and for the tapping of the rectified current, are called the auxiliary electrodes. Of the several types which have so far been developed, a few have been described in previous papers, especially the so-called "curry-comb electrode" and the wedge electrode. The former, which is now generally used in large-capacity commutators, is the one indicated in Figs. 4 and 5. The curry-comb is produced in the following manner:—In the surface of a cylindrical piece of steel a series of equidistant ribs with sharp edges are turned, or a sharp angular thread is cut. The cylinder is then bent into an arc of a circle with a radius equal to the distance from the field to the electrode in its proper position. The two curry-combs, of which the electrode generally consists, are separated by a gap through which the jet wave passes. The width of the gap is adjusted so that the ribs will cut, say, a few tenths of a millimetre into the wave. Under these circumstances there will, with the proper jet wave, be safe contact between an unimpaired wave and the electrode, and comparatively heavy currents of several hundred ampères may be passed from the latter into the wave. The deformation to which the electrode gives rise is, at the same time, relatively small.

In the problem of the tapping of the rectified current a peculiar difficulty had to be faced. In Figs. 4 and 5 the auxiliary current is transmitted into the jet wave by means of the curry-comb through which the rectified current is tapped out of the jet wave. This arrangement, with a single joint electrode instead of two—as in Fig. 2—has proved adequate as long as the rectified current is small compared with the auxiliary current. Generally, however, this is not the case, and a complication arises which, however, has been overcome.

THE COMPLETE RECTIFIER AND THE RECTIFIER PLANT.

The so-called six-phase series rectifier, which is considered here exclusively, consists, as indicated, of three commutators, or aggregates of commutators, connected in series. The component commutators are generally mounted in a joint chamber. The chamber is kept filled with hydrogen because this gas alone of all gases—barring, perhaps, helium—is able to absorb the energy of the spark within the time available for absorption to take place. The ratio of the duration of a spark in hydrogen and atmospheric air or nitrogen is something like 1 : 10.

The jet-wave rectifier was developed in the municipal power station of Copenhagen, the H. C. Oersted Works. The rectifier here used had a capacity of 200 kW at 550 volts, and the transformer was a 400-kVA, 6300-volt Siemens-Schuckert transformer. After the completion of the work of development, two complete plants were tested under ordinary working conditions. The first, a 100-kW, 230-volt plant was erected at the Northern Cable and Wire Works, Copenhagen. The plant was here used for running direct-current motors either alone or in parallel with the various direct-current sources of the works—a 200-kW rotary converter, a 500-kW motor generator, and a 500-kW turbo-generator. It was kept under observation for nine months and during this time behaved to the satisfaction of all concerned.

The other of the two plants indicated above is a 200-kW, 550-volt plant which is still in operation. The rectifier proper is the same as was used in the former test. The plant is erected in the Nordsjællands Elektricitets-og Sporveje-Aktieselskabs power station at Skovshoved, just outside Copenhagen, and is used to drive the electric street cars on the lines of that company. The plant has been kept under observation for several months and operates with complete satisfaction, handling without difficulty the disturbances which must be reckoned with in a sub-station for traction purposes.

Some interesting experiences with this plant may here be stated. The sub-station in which the rectifier was erected was supplied with power from a 50-kV main covering a good deal of the southern part of Sweden and the eastern part of Denmark. At a certain juncture very interesting large-scale experiments were carried out on this main, the latter being several times short-circuited through arcs for from 1 to 3 seconds. The result was to throw practically all rotary converters out of operation, but the jet-wave rectifier continued to operate during the short circuits, though with greatly reduced voltage, and continued working after the short circuits had ceased and the normal voltage returned. The street cars were thus practically uninfluenced by the severe disturbances on the main, and it was probably not even noticed that experiments were being carried out.

Later, the effect on the rectifier of direct short circuiting of the street car feeder proper, and thus of the direct-current circuit of the rectifier, was investigated. Three feeders, each with its maximum circuit breaker, were operated in parallel by the rectifier, and one of the feeders was short circuited. The effect on the rectifier was hardly perceptible, and the operation of the two parallel feeders was by no means affected. The short-circuit current per commutator was estimated as 1000 ampères, *i.e.*, more than five times the normal load current.

From these tests it may be concluded that the jet-wave rectifier has been developed into a perfectly reliable direct-current source, allowing, of course, for such transient irregularities as are likely to occur in the course of the development of any new apparatus.

CONCLUSIONS AND ANTICIPATIONS.

The new rectifier has hitherto been produced for outputs up to 200 kW or 300 kW—with six commutators—and for voltages from 220 to 550 volts. It is hoped that the present paper will leave no question as to the practicability of rectifiers for larger capacities. Obviously, jet-wave rectifiers of any size may be produced on the basis of the theoretical and experimental knowledge at hand in connection with the constructional members available. With regard to such very large systems, it may be anticipated that the efficiency will be slightly raised and that the amount of mercury required per kilowatt will diminish. An interesting question is whether the interval for the direct-current voltage can be extended; and there is no doubt that it can. It has been found that the efficiency of a 230-volt rectifier can be made nearly as high as that of a 550-volt plant with practically the same commutator. With a special main electrode the resistance of the commutator can be very considerably reduced, and as it is the resistance which is the predominant factor with low-voltage rectifiers, it may be concluded that economical rectifiers for 110-volt or probably even 55-volt, direct current may be constructed. On the other hand the only reason why 550 has hitherto been the limiting voltage in the development is the accidental circumstance that rectifiers of this voltage could easily be tested on traction service. Obviously, if an economical 200-kW, 500-volt rectifier is developed, a 600-kW, 1500-volt rectifier of at least the same efficiency is equally practicable, in that three commutators per phase can be used in series. But, as a matter of fact, there is nothing to indicate that it will prove necessary to build a 1500-volt rectifier from commutators of

(1500/9), *i.e.*, 167 volts. Commutators for much higher voltages can undoubtedly be produced, so that most likely a 1500-volt rectifier can be made from three commutators for 500 volts each, and possibly a 3000-volt rectifier from three commutators for 1000 volts each. With such a rectifier the main current loss will, with the same capacity commutator, be reduced to one third of that in a 500-volt rectifier, *i.e.*, the efficiency will be raised by more than 1 per cent.

Rectifiers of 1500 or 3000 volts are, however, not our final goal. The author is convinced that the jet wave commutator affords a practical means for the production of very high direct current voltages, say, 100 kV or more, and, on the basis of certain observations, would venture to predict that a 100 kV rectifier can be made from 100 very simple jet wave commutators connected in series.

In connection with the question of high-voltage production it is interesting to note that the jet-wave rectifier is capable of transforming direct-current into alternating-current energy under certain conditions. This, as will be seen, opens up the possibility of producing a direct-current transformer by means of which the high direct-current voltage suitable for energy transmission may be stepped down to a value suitable for motor operation and electric illumination.

Finally, a few words may be said with regard to the important question of the cost of production of the rectifier. The majority of the readers of this paper will probably admit that the jet-wave rectifier in its present shape is, comparatively speaking, a very simple system consisting of a few inexpensive parts adaptable to mass production. The most expensive material employed is, of course, the mercury. The amount necessary approximates at the present moment to 0·5 kilos. per kilowatt for the larger rectifiers. A further and very essential reduction may, however, be anticipated. It should be noted that absolutely no loss of mercury takes place, and that ordinary commercial mercury is perfectly suitable for the purpose. The substitution for mercury of some other metal or alloy of low melting point has been carefully considered, and this could probably be done. While it is impossible to give exact figures for the cost of production at the present stage, it seems safe to say that in this respect the new rectifier will easily compete with other available means of alternating-current rectification.

American Engineering News.

100-Ton Crane for Train Ferry.

For the new train ferry service by an English-built steamer between New Orleans and Havana, Cuba, the railway cars are handled at each port by a crane of 100 tons capacity, designed for a 10-ton cradle and 90-ton car. Instead of cars being run on and off the deck at the bow or stern, as in most train ferries, they are raised and lowered through hatchways. Tracks are provided on four decks, and the cars are moved along by cables and capstans. There are four hatchways. The ship lies alongside the crane, which has a hinged boom that is lowered to extend across the deck when the ship is moored. A trolley or traveller moves along this boom and through the tower structure of the crane. When a goods car is run on to the platform or cradle at the base of the tower, it is locked in position and the hoisting trolley raises the cradle high enough to be clear of the ship. The trolley is then traversed along the boom until the cradle is over the deck hatch and is then lowered to the required deck. The car is then hauled off by the capstan. Usually a car from the same or another deck is run on the cradle and transferred to land. The crane tower is 57ft. by 35ft., with the trolley track 60ft. above the two railway tracks which pass through the tower. Above this level the tower rises 45ft. to carry the suspension cables of the hinged boom. This boom is 72ft. long and the total length of travel of the cradle trolley is 90ft. This trolley weighs about 60 tons. The cradle hoist on the trolley is operated at 50ft. per minute by two electric motors of 400 H.P. The boom hoist on the tower has a 40 H.P. motor. On the trolley is a 75 H.P. motor for traversing along the boom.

Commercial Sand Dredging.

At Chicago and other large cities on the Great Lakes immense quantities of sand for filling low ground and for use in building operations—as in making mortar, asphalt paving, and concrete—are obtained by dredging in deep water off the shore by means of hydraulic hopper dredgers. One of these vessels can pump 1600 cubic yards of sand from the lake into the hoppers in 1½ hours, and can pump it ashore through 1500ft. of pipe line to an elevation of 35ft. in two hours. It is an ocean cargo boat reconditioned for its present service and with its hull forming two hoppers with a combined capacity of 2500 cubic yards. It is 265ft. long and 43ft. beam, with a loaded draught of 20ft. The single screw is driven by a triple-expansion engine which, with the centrifugal sand pumps and engines, is placed amidships, so that the boat will ride on an even keel whether light or loaded. There are two 20in. centrifugal pumps, each driven by a 400 H.P. triple-expansion engine running at 300 revolutions and having 18in. pipe connections. When loading, two 18in. suction pipes 60ft. long are lowered by means of winding engines, one on each side. The hoppers are 33ft. wide and 23ft. deep. For unloading, the sand is flooded by means of a high-pressure steam turbine pump, and flows to wells to which the main pump suctions are connected. In another steamer of the same class the sand is unloaded dry by means of grab buckets on derricks with long booms, the bucket either delivering the sand to stock piles on the shore or dropping it into conveyors which are swung outboard and discharge the sand at some distance from the wharf or dock.

Improvements in Iron Castings.

THAT modern improvements in cast iron make that material adapted to many special purposes for which it generally is considered unsuitable, was claimed at a recent meeting of the Gear Association. But that adaptability is not widely recognised, for, while the consumption of steel castings has increased 200 per cent. in ten years, and that of malleable iron castings 100 per cent., the increase in consumption of grey iron castings has been only about 10 per cent. Careful technical control of the character and quality of the metal has eliminated many causes of unreliability in iron castings. With improved melting conditions more definite quality is obtained, while better moulding practice results in surfaces of better finish. Grey iron is apt to be classed as a uniform material, whereas it is varied just like steel in order to meet different conditions, so that some consumers are now specifying analysis and hardness instead of purchasing only on a price basis. Many foundries operate on a basis of strength control and produce iron having a tensile strength of 30,000 lb. to 60,000 lb. per square inch. The specially hard and tough iron used for railway wheels is an example of what can be accomplished. In machine tool work there is a tendency to increase the use of steel and bronze gears, largely because of their high resistance to impact, as when starting machinery. But alloy irons are regaining this field as increased tensile strength brings still higher increase in resistance to impact. With increased strength also, the sections may be made lighter, as in the case of frames and bed-plates for machinery. Tensile strengths up to 60,000 lb. do not necessarily require special processes, as they can be produced by various alloys, alone or in combination, such as chromium, molybdenum, nickel and vanadium.

Gas Welding in Foundries.

In grey iron foundries the use of the oxy-acetylene welding process is applied mainly to the reclamation of defective castings, and is regularly employed as a production operation for the removal of surface defects, such as blow-holes and shrinkage cavities, according to a report of the Acetylene Association. Defects of this kind are often exposed only when the casting is being machined, and as the value of the casting increases with each step of the production process, the reclamation by welding increases in importance as a cost factor. In the same way welding may be used at cold-shuts, where the metal has not completely filled the mould, and it is often used to repair castings broken in handling, as in building up lugs or other projections. In steel foundries the gas is used mainly for cutting off large risers, especially on chrome-nickel and other alloy castings, for which a special form of blow-pipe or cutting torch has been developed. Many of these blow-pipes are mechanically operated, a special case being the cutting of risers 56in. in diameter to within ¼in of the finished surface. Piping systems for the gas are considered more economical than the handling of gas cylinders in the cutting room. For malleable castings, reclamation by welding is in only limited use. Bronze welding gives a strong and reliable joint, but the difference in colour is an objection. However, the oxygen torch is a valuable emergency tool for opening clogged tap holes in the air furnaces of malleable iron foundries. In non-ferrous foundries, the welding of aluminium is common, but study of the different alloys is necessary to duplicate the colour and the physical characteristics. Reclamation of castings in bronze is not general, as welding results in the loss of volatile components.

Eight-coupled Passenger Locomotives.

With increasing weight of cars and trains and increased demands for higher speeds, some railways are introducing eight-coupled engines to handle passenger trains and also the fast-freight or fast-goods trains. This applies not only where severe gradients are encountered, but also on lines in rolling prairie country. On all these engines four-wheel bogies are placed at both ends, making a 4–8–4 wheel arrangement, while the tenders are carried on pairs of six-wheeled bogies. Engines of this sort on the Chicago and Northwestern Railway have cylinders 27in. by 32in. and driving wheels 6ft. 4in. in diameter, with 144 tons on the drivers and 245 tons total weight. Their tractive force is 65,200 lb., or 76,500 lbs. with the booster engine operating on the rear bogie. Similar engines on the Great Northern Railway, which are not equipped with boosters, have the following dimensions :—

Type	4–8–4
Cylinders	28in. × 30in.
Driving wheels	6ft. 1in.
Leading bogie wheels	3ft.
Trailing bogie wheels	3ft. 9in.
Driving journals	13in. × 14in. and 12in. × 14in.
Wheel base, driving	19ft.
Wheel base, rigid	12ft. 8in.
Wheel base, total engine	45ft. 6in.
Wheel base, engine and tender	94ft. 10in.
Weight on drivers	136 tons
Weight on leading bogie	44 tons
Weight on trailing bogie	54 tons
Weight of engine	234 tons
Weight of tender	186 tons
Water in tender	22,000 gallons
Fuel oil in tender	5,800 gallons
Boiler pressure	250 lb.
Boiler diameter	7ft. 4in.
Fire-box	12ft. × 8½ft.
Combustion chamber, length	3ft. 9in.
Tubes, 2¼in. diameter, number 61, diameter	2¼in.
Superheater tubes, number 210, diameter	3½in.
Length between tube plates	22ft.
Grate area	102 sq. feet
Heating surface, fire-box	296 sq. feet
Heating surface, tubes	5,004 sq. feet
Heating surface, combustion chamber	105 sq. feet
Total evaporative heating surface	5,405 sq. feet
Superheating surface	2,444 sq. feet

Developments in Feed-water Treatment.

Two lines of investigation now being carried out are the mechanism of priming and foaming of water under steam conditions and the determination of the hydrogen-ion concentration in concentrated boiler water, the first relating to the problem of wet steam and the second to corrosion of boilers and appurtenances. An interesting recent development is the combination of purification processes. Thus the combination of chemical and zeolite softening, additions of coagulants with softening reagents, the continuous blow-down system and the use of steam purifiers is said to have revolutionised feed-water treatment. Re-circulation of concentrated boiler waters has not been employed extensively, but some recent novel applications have been made, either with heat recovery only or with boiler heat recovery and water softening. A marked increase in the use of phosphates and sodium aluminate as softening reagents is attributed to the supply of purer materials and a more exact knowledge of their value for specific conditions. While di-sodium and tri-sodium phosphate have been used more generally, there is now a mono-sodium phosphate which has an advantage in that the soluble phosphate is obtained with less concentration of the sodium radical. Further study is being made of inhibition of corrosion by electrolytic methods, but much experimental work is needed to determine the mechanism of the retardation of corrosion. Non-condensible gases in steam, especially carbon-dioxide, are causing trouble, and acid steam seems to be rather frequent. Dissociation of even pure water is a possible occurrence in steel economisers and superheaters, with serious detrimental effect upon the steel. But the study of this problem has only just begun. Among the investigations of industrial water treatment is one on the mechanism of scale formation, which may lead to the control of scale in boilers and evaporators.

Tests on Scotch Boilers Fired with Powdered Fuel.

WE have received from the Brand Powdered Fuel System, Ltd., some details of two recent tests which were made on a three-furnace marine boiler, at the works of the Wallsend Slipway and Engineering Company, Ltd., and on board the cargo ship "Swiftpool," a description of which ship will be found in our issue of August 2nd, 1929. The Wallsend boiler, is of the single-ended type, with three furnaces, had an internal diameter of 13ft., with a length of 11ft. 6in., and a heating surface of 1850 lb. per square inch, the designed working pressure being 200 lb. per square inch.

On the occasion of the eight-hour trial the boiler was fired with "Benwell" small coal, having a calorific value of 14,020 B.Th.U. per lb. The pressure was maintained at 195 lb. per square inch, and the temperature of the feed was 58 deg. Fah., with an atmospheric temperature of 66·6 deg. Fah. The secondary air was supplied at 251 deg. Fah., and the primary air at 171 deg. Fah., the average flue gas temperature recorded in the smoke-boxes being 628 deg. Fah., with a funnel temperature of 516 deg. Fah., the average draught being about —½in. The average CO_2 content recorded at the smoke-box was 15·1 per cent. Under these conditions the actual amount of water evaporated per lb. of coal was 9·79 lb., corresponding to a gross thermal efficiency of 82·6 per cent. The actual evaporation per hour was 11,748·3 lb., or 6·35 lb. per square foot of heating surface, with a heat release of 46,700 B.Th.U. per cubic foot. The boiler was afterwards run continuously for fifteen days with an average efficiency of 80·5 per cent., and five different grades of coal were used, no difficulties, we learn, being experienced either with slag or with dust.

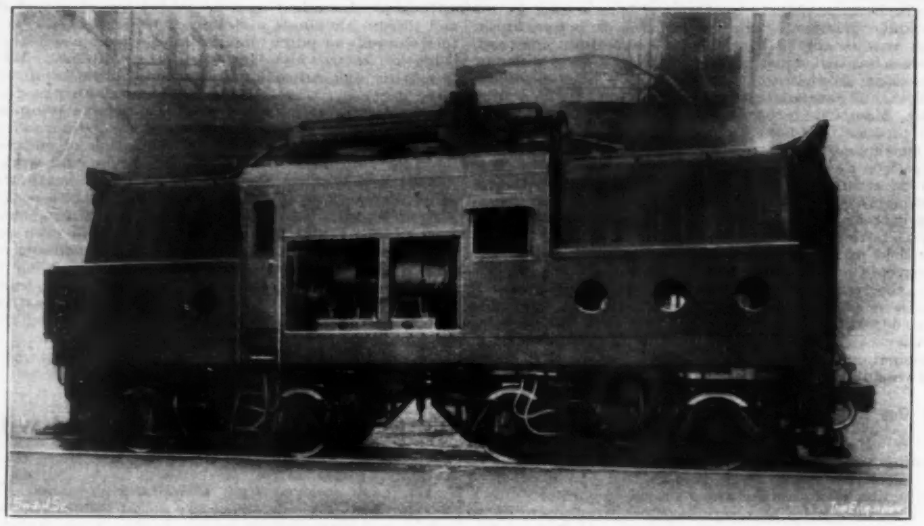
The trials, which were carried out on the "Swiftpool" during December last, took the form of a six-hour basin trial followed by a fifteen hours' trial at sea, with the ship in the deep-loaded condition. In what follows we give a summary of the results obtained. The boiler installation of the "Swiftpool" comprises three 16ft. diameter by 11ft. 6in. long, three-furnace Scotch boilers, each having a heating surface of 2676 square feet and designed to work at a pressure of 180 lb. The centre boiler is used as a donkey boiler, and is hand fired, the port and starboard boiler being arranged for powdered fuel firing on the Brand system. The steam is supplied to a single-screw installation of triple-expansion engines. In the fifteen hours' trial carried out on December 13th, the average steam pressure was 170 lb. per square inch, with a feed temperature of 134 deg. Fah., the atmospheric temperature being 60 deg. Fah. The primary air was supplied at 205 deg. Fah., and the average temperature of the flue gases at the backs of the boilers was 1300 deg. to 1390 deg. Fah., the funnel temperature being about 526 deg. Fah., a furnace draught of about —½in. being maintained. The percentage of CO_2 measured at the smoke-boxes was 13·8. An actual evaporation of 10·43 lb. of water per lb. of coal was obtained, corresponding to a gross thermal efficiency of 81·6 per cent. The evaporation in actual pounds per hour was 30,700, and 5·75 lb. per square foot of heating surface, with a heat release of 39,400 B.Th.U. per cubic foot. The engines developed an output of 1810 I.H.P., and the pounds of water per I.H.P. hour worked out at 16·95, with 1·625 lb. of coal per I.H.P. hour. During this particular trial "Townley" smalls with a calorific value of 13,480 B.Th.U. per lb. were used. The readings referred to were taken by the Wallsend Slipway and Engineering Company, Ltd., and we are informed that these results are being steadily improved upon as the engineers gain experience with the plant under their charge.

The "Swiftpool" is now on her third trip, and is approaching Rio de Janeiro. She recently completed a successful voyage to Savona, Italy, and on the homeward journey maintained an average speed of about 10·2 knots. When at Cardiff recently no less than five different varieties of coal were bunkered, most of the fuel being very wet, and the figures for the present voyage should give some indication of the difference made by these fuel conditions in the working of the plant and the production of steam.

FACTS and figures showing that more ships are being built with fewer men employed are given by Mr. John Hill, general secretary of the Boilermakers' Society, in his February report. He states that though the output for 1929 was 22,000 tons in excess of that in 1921, 72,000 fewer men were employed. In eight years 153,337 men have been eliminated from the industry. This tendency, which is evident in all the heavy industries, the report adds, has an important bearing on the unemployment problem.

600 H.P. ELECTRIC LOCOMOTIVE

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., PITTSBURGH, ENGINEERS



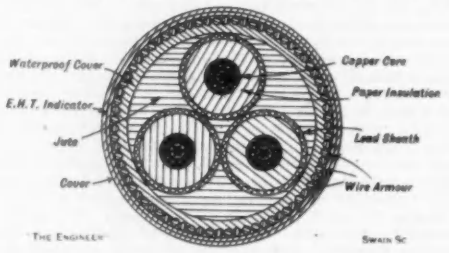
A Storage Battery Trolley Locomotive.

AN interesting locomotive built during last year by the Westinghouse Electric and Manufacturing Company, of Pittsburgh, is one of 75 tons and 600 H.P., which operates normally from a 600-volt overhead wire, but, carrying a storage battery, can also work on tracks which have no current supply. As will be seen from our illustration, it follows American standards throughout. It handles ore trains being loaded by great electric shovels on the benches of a huge open pit mine. In this area, where overhead wires would be in the way, it runs on the battery. Returning to the trolley, it takes the full ore trains down the mountain and brings up empties. The air brake compressors with which it is fitted also serve as a supply for pneumatic car dumping. The engine is carried on a pair of four-wheel swivel trucks, with four geared, axle-hung motors. We are told that, considering that it carries a battery, it is hardly heavier than many normal trolley locomotives of equal power without a battery.

Electrical Distribution in Manchester.

A PAPER dealing with the distribution of electricity by the Manchester Corporation was read before the Manchester Association of Engineers on Friday, January 24th, by Mr. H. C. Lamb, M.I.E.E., M.I. Mech. E., the Chief Electrical Engineer to the Corporation. Mr. Lamb said that in present-day systems capital charges are by far the most important consideration, and usually the capital expended on transmission and distribution exceeds that expended on generating stations. The modern tendency to concentrate generation in a small number of large stations obviously increased the cost of distribution, but it lowered the capital cost of power stations, gave the highest operating efficiency, reduced the standby plant required, and enabled full advantage to be taken of the important factor of diversity by combining in one station the industrial, commercial, suburban and transport loads.

With regard to the distribution in Manchester, Mr.



SCREENED CORE HIGH-TENSION CABLE

Lamb said that as a result of the controversy some thirty-five years ago unfortunately the views of direct-current champions mostly prevailed, and this was the case in Manchester. In order to avoid the inevitable loss by distribution at 200 volts—the then pressure—a five-wire scheme was developed, and this made it possible to distribute at 400 volts and to supply pressure as low as 100 volts for lighting.

The supply of high-tension current in Manchester really began in 1902; this was three-phase at 6600 volts and 50 periods, but in 1919 Manchester and Salford were connected by a cable to carry 33,000 volts. This was the first attempt in the country to carry this pressure, and the Barton station with its connected system of 33,000-volt underground lines was brought into use in 1923. The main transmission lines now go to seven points where the current is transformed down to 6600 volts and is fed to other distributing stations at that pressure.

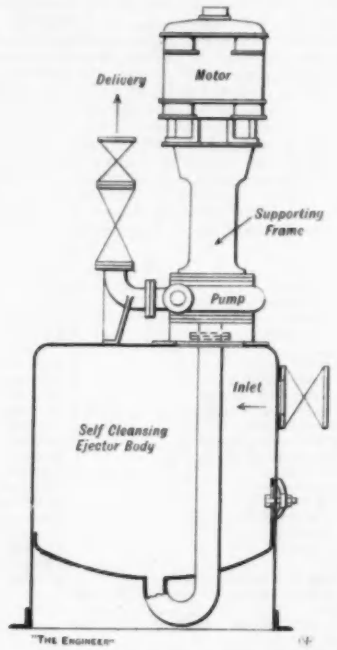
Referring to certain failures of these high-tension cables, Mr. Lamb said new types of cable had been evolved in which each of the cores is screened by a metallic sheath, and experience with these had so far been successful. A section of this cable is given herewith. The advantages of this cable over the old belted type are:—The stress is radial and even; the difference of pressure across the di-electric is limited by the pressure to the earth; and all the faults must be earth faults.

Referring to the "grid," Mr. Lamb said that just as the original primary 400-volt mains of 1893 became secondary mains when in ten years' time a system of 6600-volt mains was inaugurated, and then twenty years later the elaborate 6600-volt network became a secondary by the introduction of 33,000 volts, so now, at the end of the fourth decade, the 33,000-volt feeders become secondaries to the 132,000-volt grid.

Automatic Sewage Lifting Plant.

FOR automatically removing sewage, which cannot flow away by gravity, a self-starting and stopping plant has recently been introduced by Daniel Adamson and Co., Ltd., of Dukinfield. It has been named by its makers the "Eject-o-Pump," and it is shown diagrammatically in the accompanying engraving.

The sewage is received through a valve into a closed chamber, or hopper, which has smooth walls and floor. This chamber is provided to take the place of an open sump, and to keep the sewage in an enclosed circuit so that no noxious gases may be discharged into the atmosphere. Mounted on the top of it is a vertical-spindle "Chokless" pump, having an impeller specially designed to handle crude sewage. The pump spindle is prolonged and is coupled direct to the spindle of an electric motor, which sits on a supporting frame that is bolted to the pump casing. The pump suction is connected, by a pipe having a reverse bend, to an orifice in the centre of the floor of the receiving chamber. This construction, it is claimed, renders the hopper self-cleaning, since the solids slide down the smooth walls and floor and pass away with the flow of sewage.



"EJECT-O-PUMP" SEWAGE PLANT

The apparatus is operated by an air pressure control switch, which is entirely automatic in its action. A stand pipe is fitted to the sewage chamber, and from the top of it a smaller pipe leads to the control element. As the sewage chamber fills, the air in the stand pipe is compressed and the pressure is transmitted to the surface of a column of mercury in a tube, with the result that the column is forced downwards. The bottom of this tube is connected to two other tubes, so that when the mercury is depressed in the first tube, as a consequence of a rise in pressure in the stand pipe, it rises in both the latter. A further tube contains a starting contact, and a still further tube a stopping contact. The operation of the plant is, therefore, entirely automatic, the motor starting up when the level of the sewage in the receiving chamber rises to a certain point, and stopping when it falls again. The starting and stopping levels are adjusted by means of two knobs, or the like, and there is a calibrated scale to enable the setting to be easily performed.

These plants are, we understand, made with capacities of from 25 to 1000 gallons per minute, and the following claims, in addition to those already mentioned, are made for them:—They operate noiselessly; are extremely simple, durable and reliable; and their component parts are readily accessible.

HACK SAW BLADES.

MORE than ten years have now elapsed since the British hacksaw makers brought into operation a standard price list for hacksaw blades. During this period certain anomalies and inaccuracies in the list prices have become apparent, more particularly in regard to those of the light power and double edge blades.

With a view to correcting these and also arriving at some measure of simplification, the British and American Hacksaw Manufacturers' Associations have agreed upon a new price list on the more practical basis of a price per lineal inch for each width and gauge, eliminating thereby the inaccuracies referred to. It is anticipated that the German Hacksaw Makers' Association, with whom the British makers have been in negotiation, will also adopt the British-American list. This is believed to be the first international list for tools.

The new list includes sixty-one sizes only, which should meet all requirements. The official list of 1919 included 139 sizes, a large number of which were quite redundant.

It is, of course, realised that in certain instances special sizes may be required, and whilst such unlisted sizes will be quoted for and made to order, they will be subject to normal manufacturing delay. It will be appreciated, however, that when making sizes in dimensions other than those listed, it is impossible for the manufacturer to work to exact quantities, and as in the future any sizes other than those listed will not be stocked, orders for special sizes can only be accepted on the understanding that the manufacturer can supply all that are made within 20 per cent. more or less of the quantity specified.

It is, however, confidently anticipated that users of hacksaw blades will adopt the sizes listed as standard for their future requirements. Previously an individual maker may have listed certain sizes which another manufacturer did not make, but after much time spent in thoroughly discussing the whole problem from all aspects, the manufacturers have unanimously adopted the sixty-one sizes indicated above.

The new prices, with those few exceptions where anomalies have been corrected, do not differ to any considerable extent from those of the old list; in consequence, no alteration in the discounts of the individual manufacturers at present generally ruling is involved, and therefore no undue disturbance to the hacksaw market will result on its introduction on May 1st, 1930, after which date all orders will be executed at the new prices.

LAUNCHES AND TRIAL TRIPS.

BRADGLEN, steamship; built by Wm. Gray and Co., Ltd., to the order of Sir William Reardon Smith and Sons, Ltd., Cardiff; dimensions, 400ft. by 54ft. 3in. by 28ft. 0½in.; to carry grain cargoes. Engines, reciprocating of the balanced quadruple inverted direct-acting surface condensing type, pressure 260 lb. per square inch; constructed by the builders; trial trip, February 6th.

PORTREGIS, steamship; built by Craig, Taylor and Co., Ltd., to the order of Portfield Steamship Company, Ltd., Cardiff; dimensions, 392ft. 6in. by 52ft. by 27ft. 8in.; to carry cargo. Engines, triple-expansion, 24½in., 41in., 67in. by 45in. stroke pressure 180 lb. per square inch; constructed by Blair and Co., Ltd.; trial trip, February 6th.

BARON NAPIER, cargo steamer; built by David and William Henderson and Co., Ltd.; to the order of H. Hogarth and Sons; dimensions, length 350ft., breadth 50ft., depth 25ft. 9in. Engines, triple-expansion, 21½in., 37in., 62in., by 42in. stroke, pressure 210 lb. per square inch; constructed by the builders; launch, February 12th.

CITY OF BARCELONA, single-screw steamer; built by Barclay, Curle and Co., Ltd.; to the order of Ellerman Lines, Ltd.; dimensions, length 425ft., breadth 58ft., depth 29ft. 9in.; to carry 5600 tons. Engines, four-crank triple-expansion, 23½in., 40½in., 50in., 50in. by 48in. stroke, pressure 265 lb. per square inch; constructed by the builders; launch, February 12th.

H.M.S. FOLKESTONE, sloop; built by Swan, Hunter and Wigham Richardson, Ltd. Propelling machinery and water-tube boilers constructed by R. and W. Hawthorn, Leslie and Co., Ltd.; launch, February 12th.

LOSSIBANK, twin-screw motor ship; built by Workman, Clark (1928), Ltd.; to the order of Andrew Weir and Co.; dimensions, length 440ft., breadth 57ft., depth 38ft. 7in. Engines, five-cylinder Sulzer; constructed by the builders; launch, February 12th.

MAPIA, motor vessel; built by "De Maas" Shipbuilding Company; to the order of the Royal Packet Company; dimensions, length 165ft., breadth 28ft. 8in., depth 10ft. Engines, five-cylinder Diesel, 250 I.H.P.; trial trip, February 12th.

PRINCE DAVID, steamer; built by Cammell, Laird and Co., Ltd.; to the order of Canadian National Steamships; dimensions, length 384ft. 6in., breadth 57ft., depth 20ft. 2in. Engines, two sets single-reduction geared Parsons turbines, pressure 350 lb.; constructed by the builders; launch, February 12th.

SILVONIA, steamer; built by R. Williamson and Son, Ltd.; to the order of North-West Shipping Company, Ltd.; dimensions, length 211ft., breadth 33ft. 3in., depth 15ft. 6in.; to carry 1500 tons deadweight. Engines, triple-expansion, 15in., 26½in., and 44in. diameter by 30in. stroke, pressure 200 lb. per square inch; launch, February 12th.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Industrial Outlook.

WHILE the general depressed condition of industry in the Midlands and Staffordshire and restricted activity in the iron and steel market is unrelieved, the gathering together of producers and consumers at the British Industries Fair at Castle Bromwich has resulted in revived hopes, for it has given promise of increased market activity in the near future. The demonstrating of their products by Midland producers to thousands of home and foreign buyers cannot help but ensure increased interest on the part of the buyer, and at the time of writing some very useful orders had been obtained to help local manufacturers on the road to better times. The weekly meeting of the iron trade in Birmingham this week produced nothing of a spectacular character. Interest was divided between it and the Fair. There was perhaps a little more activity than at recent meetings, but there was little big business about.

The Pig Iron Situation.

An encouraging feature in an otherwise dull market is furnished by the production statistics for January. Output of pig iron during the month amounted to 650,000 tons, compared with 643,000 tons in December and 563,900 tons in January, 1929, despite the fact that there was a decrease of three furnaces in the total in blast throughout the country. The number of active furnaces is now 159. It is interesting to note that the production included 198,100 tons of hematite, 264,500 tons of basic and 159,900 tons of foundry and forge pig iron. Midland users of pig iron are purchasing on a hand-to-mouth basis, and Northamptonshire and Derbyshire smelters complain that specifications against old contracts are unusually slow. It is very doubtful whether current output is being fully absorbed, but it is only in rare cases that stocking of foundry iron at the furnaces is talked of. Consumers on 'Change in Birmingham this week expressed dissatisfaction with the present level of prices and gave it out as their belief that there will be no revival of demand until pig iron is cheaper. Some consumers who have been contending that the prices fixed at the end of September are higher than demand can stand, are confirmed in the determination to confine their purchases to the minimum. Some blast-furnacemen were inclined to modify their attitude, but they questioned whether a lowering of the price would have the effect of re-invigorating trade. The answer would seem to depend upon the demand for finished products, and that is just now in an indeterminate position. Again, the pig iron producer bases his calculation to some extent on the cost of coke, and although purchases have recently been made on a slightly lower basis, the reduction is not considered sufficient to warrant any concession in selling prices of pig iron. They point out that while pig iron prices have been raised by from 8s. 6d. to 10s. per ton, coke has advanced by 5s., or more. On a rough basis of 30 cwt. of coke to a ton of pig iron, there is no room to accuse them of over-inflation of prices, especially when the unremunerative level at which raw iron prices stood before makers combined to safeguard their common interests is borne in mind. Business is so much more unstable than it was at the beginning of the year, however, and furnacemen are so disinclined to put material into stock that it is quite conceivable that the Pig Iron Producers' Association may consider it advisable in the near future to make some price concession to encourage consumers to freer buying. At any rate, many users in this area hold this opinion.

Steel Trade.

In the steel trade there is a shortage of specifications for building steel, owing to the quietness of trade amongst constructional engineers. The excess of output capacity at the steel mills has been accentuated by the deterioration since the year opened. At the plate mills, especially, the slowness with which contractors are specifying is causing anxiety. The Steel Association maintains its prices of £8 10s. for joists, £8 7s. 6d. for angles, and £8 17s. 6d. for plates, subject to the usual rebate where users agree to consume British material only. In the smaller sizes of steel and semi-finished material, such orders as are being given out are mostly for small tonnages. Some of the South Staffordshire strip mills are doing reasonably well, though they are not able to make full time. Mild steel billets are offered at £6 5s. That is the price which applies to the bulk of the business now passing, but large buyers are able to obtain 2in. and 3in. billets at £6 2s. 6d. per ton. Makers of small bars continue to ask £8 upwards for their output. They are moderately well employed. Continental semis have advanced 1s. per ton, making billets £5 9s. to £5 12s. 6d., according to size, delivered in South Staffordshire. Some imported finished steel has been raised 2s., bars being quoted about £6 9s. The January production of steel ingots and castings, amounting to 771,100 tons, compared with 661,200 tons in December, when production was affected by the holiday period, and 764,600 tons in January, 1929, is considered reasonably satisfactory.

Staffordshire Bar Iron.

In the finished iron trade of South Staffordshire moderately good business is being done in marked bars, and a few fortunate firms which are able to command regular outlets for this high-class engineering material have really good orders on their books and bright prospects. Larger tonnages are being called for on account of railway work. The price is upheld at £12 10s. per ton. Some ironmasters report more activity in chain and cable material, but conditions vary considerably at the numerous Staffordshire works. Makers of Crown iron keep up their prices at £10 to £10 10s. In some quarters it is thought that they might do a larger trade if they could afford to sell on a somewhat lower level, but that is very questionable. They would need at least to bring their selling figure in line with that of makers in other districts. Even then, consumptive demand is such as hardly to encourage the hope of any real increase in the volume of business to be secured. The output of nut and bolt and fencing iron is comparatively small. It costs £9 2s. 6d. upwards, but in recent years a good deal of the trade has been lost to continental competitors, and there is still a wide gap between home and foreign prices. It now appears almost certain that Belgian No. 3 iron will be dearer as the result of efforts made abroad to raise the standard of prices, but the increase is unlikely to be such as materially to close the gap which at present separates home and foreign prices in this branch of the market. Native makers seem to have an almost hopeless chance. Nut and bolt manufacturers appear quite content with Belgian material, and claim it would be impossible for them to use Staffordshire common bars at present prices and compete successfully for business. There is no change in the position at the strip mills and output is being pretty generally absorbed. Values remain at £11 2s. 6d. per ton.

Still Cheaper Sheets.

Efforts to stop the decline in values of galvanised sheets have been made in the Midland market, but the pressure for business has been so severe that mills have been again forced to reduce quotations. Twenty-four gauge galvanised corrugated sheets were procurable from several sources this week at as low as £11 10s. per ton. Mills which a week or so ago had the good fortune to sell their output over the next month at £11 12s. 6d. decline to entertain the lower price. The slightly improved inquiries alike from buyers at home and abroad is maintained this week, but the Indian market, which is usually responsible for a considerable proportion of the British output, remains unresponsive to makers' overtures.

Scrap.

Birmingham merchants handling steel scrap find consuming works unable to take further deliveries. Sellers are eager to secure a more remunerative price, though in the present state of trade the works are not eager to make contracts.

Disquieting Trade Returns.

The trade returns for January received, in Midland and Staffordshire industrial circles, more attention than usual, as just now every indication of trade fluctuations is being sharply scrutinised with the object of discerning if possible hope for the future recovery of industry. The scrutiny proved disquieting, and it had to be admitted that on the best reading the year's start did not give much encouragement, especially to manufacturers of finished goods in this area. The increased coal sales were a very poor compensation for the reduced exports of manufactured goods. Exports of iron and steel were down by nearly a million pounds, and more disquieting still, there was a drop of a million and three-quarters in the group that includes locomotives, ships and motor cars. The motor car and motor parts section was £200,000 down. At the same time, there was a big decrease in imports of raw material. Though it is unwise to draw broad conclusions from the business done in any one month, yet it seems very clear that, in so far as the export trade is concerned, at any rate, manufacturers cannot be certain of the future and can hardly be expected to produce with enthusiasm.

Motor Boat Engines.

There is every prospect of Wolverhampton adding yet another to its list of industries, for negotiations are practically completed between Mr. Arthur Bray, the importer, and the local firm of Turner Motor Manufacturing Company for the production of sideboard motors. It is understood that the engine is a development of the popular outboard motor, which, of course, as is well known, can be fixed to the stern of any boat. Outboard motors have, however, been getting heavier and heavier, and the sideboard motor is an attempt to revert to the old ideal of complete portability. The Konig-Bray side board motor which the firm is to make, weighs only a few pounds and is of less than three-quarters of a horse-power. It is extremely simple in design, having no valves, water pump—although it is water-cooled—or carburetter, the place of the latter being taken by a patented fuel valve. It can be instantly clamped to the side of any boat, which it will propel at several miles an hour. Up till now it has been imported from Germany, but so successful has it been that Mr. Arthur Bray, the importer, has decided to make it over here.

Engineers at Dinner.

At the annual dinner of the Birmingham and District Association of the Institution of Civil Engineers at Birmingham on the 13th inst., there were present representatives of various branches of engineering under the chairmanship of Mr. Robert Green. Mr. W. R. Sydney Speed—chairman of the Warwickshire, Staffordshire and Worcestershire branch of the Surveyors' Institution—in toasting the "Institution of Civil Engineers," said that civil, mechanical, structural, electrical and automobile engineers were working to-day for the common good of the community. Engineering, whilst on all fours with the work of a hundred years ago, was now on a much higher plane. Mr. T. H. Bailey, a member of the Council of the Institution of Civil Engineers, responded. The vice-chairman of the Birmingham and District Association—Mr. H. C. Whitehead—proposed the toast of "The Guests," to which the chairman of the Midland branch of the Institution of Mechanical Engineers—Mr. F. Samuelson—responded. In toasting the "Birmingham and District Association," Dr. H. H. Jeffcott—secretary of the Institution of Civil Engineers—said that they must not overlook the wide character of their profession. There was a tendency nowadays to think that civil engineering represented only one part, some sort of structural engineering, but he reminded them that the term was used originally when there was a distinction between military and civil engineering. The work of the civil engineer was now increasing in all directions.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Textile Machinists' Poor Start.

MAKERS of textile machinery, who, on account of depression in the home industries, are having a thin time in the domestic market, have made a poor start with the year's trade with overseas markets. January exports of textile plant reached a total of only £863,671, compared with £1,055,027 in the corresponding month of last year, and £1,079,788 in January, 1928. Last month's total included 6898 tons of spinning and twisting machinery, valued at £632,581, and 1691 tons of weaving machinery of a value of £147,836. Except for relatively unimportant expansions in the takings of China and the United States, the decline has been pretty general in all markets. British India still takes the lead, shipments thence being valued at £248,782, followed by France with £69,540, Japan £66,534, China £63,432, Germany £44,778, the United States £42,065, Russia £40,210, the Netherlands £39,976, South America £32,159, and Australia £18,331. Shipments to "other European countries" showed a heavy drop from £215,307 in January of last year to £141,878 during the month under review.

Industrial Ups and Downs.

A reduction in the net profit from £25,683 in 1928 to £14,669 last year, and in the ordinary dividend from 10 to 7 per cent., is disclosed in the annual report of Burnell and Co., Ltd., galvanised sheet manufacturers, of Ellesmere Port, Cheshire. The directors explain that during the latter half of the year there was considerable disorganisation within the industry as a whole, which resulted in low prices, and at times a temporary slowing down of production. The total volume of the company's business, however, shows an increase on the year. A further increase in net profit is reported by the directors of Crossley Brothers, Ltd., gas and oil engine makers, of Manchester. From £51,882 in 1927 and £56,813 in 1928, there has been an increase to £60,340 for last year, although no distribution on the ordinary shares, which have received nothing since 1920, is recommended. After providing for the preference dividend, £157,403, compared with £125,300 in the previous year, is carried forward. A final dividend on the ordinary shares of 5 per cent., and a bonus of 5 per cent., both free of income tax, are recommended by the directors of Mather and Platt, Ltd., engineers, of Newton Heath, Manchester. The total distribution for the past year is thus 15 per cent., the same as in the previous seven years. A heavy decline in net profit, from £50,329 in 1928 to £21,585 last year, is reported in the case of Willys Overland Crossley, Ltd., motor car manufacturers, of Heaton Chapel, near Manchester. At the end of 1929 stock-in-trade and work in progress were valued at £536,823, compared with £449,223 at the end of 1928.

Iron, Steel, and Coal Merger.

The annual report of the Wigan Coal and Iron Company, which shows a net profit for 1929 of £62,965, compared with a trading loss of £58,511 in the previous year, refers to an important scheme of amalgamation with other Lancashire interests, a provisional agreement regarding which has been entered into. The other concerns are the Partington Steel and Iron Company, the Pearson and Knowles Coal and Iron Company, Rylands Brothers, the Wigan Junction Colliery Company, and the Moss Hall Coal Company. It is pointed out that if the scheme matures the amalgamation will have the control of blast-furnaces, coke ovens, steel furnaces, foundries and rolling mills at Irlam, collieries at Lower Ince, near Wigan, and elsewhere, and collieries, forges and wire-drawing works at Warrington, and, in addition, will own leases of ironstone mines in Northamptonshire and limestone quarries in North Wales, as well as the various interests of the Wigan Coal and Iron Company. A special meeting of shareholders of the Wigan Coal and Iron Company has been called for Friday of this week.

£2,000,000 Port Improvement Scheme.

The Mersey Docks and Harbour Board's scheme for the modernisation of the central dock system of Liverpool and the construction of a new dock at Bidston, Birkenhead, estimated to cost about £2,000,000, has been approved by the Government, which is to make a special employment contribution to the cost. An early start with the work is to be made.

Local Contracts.

It is announced that Edmund Nuttall, Sons and Co., of Old Trafford, Manchester, who are the contractors of the new Mersey tunnel from Liverpool to Birkenhead, have secured the contract for the construction of the tunnel roadway. This will carry four streams of traffic, and the Manchester firm's tender, which was accepted by the Mersey Joint Tunnel Committee last week, was £250,000. An electric storage battery equipment, costing £21,000, have been supplied by the Chloride Electrical Storage Company, Ltd., of Clifton Junction, near Manchester, to the Bragesgade power station, Copenhagan.

Non-ferrous Metals.

With the sole exception of lead, all varieties of non-ferrous metals have lost ground during the past week, the worst sufferer relatively being copper. The demand for the latter since my last report has been by no means extensive, either for standard brands or for refined, and the tendency of the market has been decidedly bearish, with standard cash lower on balance by rather more than £4 a ton, the loss in the case of forward positions being much less. Warehouse stocks of tin in this country continue to increase, and at the moment the price outlook is not too strong. During the early days of the present week, however, there has been a recovery from the worst, with a net loss of from £1 10s. to £2 a ton compared with a week ago. In spite of a comparatively poor demand for the

metal, lead has been maintained at about the level of prices that has been ruling during the past month or two. With regard to spelter, however, inherent weakness in this section of the market continues to make itself felt, due, in no small measure, to the fact that the statistical position in consequence of the heavy available stocks is all against any real strength. The loss on the week has been between 7s. 6d. and 10s. a ton, bringing prices at the moment of writing nearer £19 than £20 a ton.

Iron and Steel.

Although all foundry iron prices have been well held, conditions in the market at the moment are extremely dull, interest in forward buying here having pretty well evaporated. So far as deliveries for consumption are concerned, these in the aggregate are little below the level of a month or two ago, and sellers have no particular complaint in this respect, although they are certainly complaining of the lack of fresh orders. Derbyshire and Staffordshire pig irons are at 77s. per ton, for delivery in the Manchester zone, with Scottish makes at about 95s., and hematite at 92s., also delivered equal to Manchester. There is only a quiet demand about for bar iron, with Lancashire Crown quality bars at £10 15s., and No. 2 material at £9 15s. New business in steel is also the subject of complaint by rolling mills offering on this market. There is a moderate movement in the case of boiler plates for the locomotive industry, but constructional materials, general plates, and almost all varieties of bars are in limited demand, and delivery specifications are the reverse of satisfactory. In no respect, however, has there been any alteration in quotations for home-produced steels, although imported kinds, with the exception of wire rods, have hardened since last week to the extent of about 2s. 6d. a ton all round. Sellers of continental materials report only a very patchy demand for both finished and semi-finished products.

BARROW-IN-FURNESS.

Hematite.

The West Coast hematite pig iron trade continues to be satisfactory, and most of the makers are well booked forward. What direction the market will take in a few months' time remains to be seen. The continued demand locally on steel account is maintained, and this is a means of keeping stocks down. In a few places there are some stocks of pig iron, but they do not amount to much. Buyers have covered themselves until the end of April. The home trade is steady and the same remark applies to continental business. American trade is a little better, and there is some Canadian business, which is encouraging. The local ore trade is about the same. Foreign ore is in steady demand. The steel trade is fair, and local mills are engaged on railway material, and present orders will keep them going for a period, but fresh orders would be welcome. There was a dispatch of rails last week from Barrow for South America—part of the rail order placed in this country some months ago.

Shipbuilding.

Vickers-Armstrongs, Ltd., have completed H.M.S. destroyer "Arrow." She left Barrow docks on Saturday last for the Clyde to undergo her speed trials. The "Arrow" has a length of 312ft., 32ft. 3in. beam, and 19ft. depth. She has a tonnage of 1300 and her geared turbines are designed to develop 34,000 S.H.P. The Isle of Man Steam Packet Company's new steamer "Lady of Mann" will be launched on Tuesday, March 4th. This ship will be named by the Duchess of Athol.

SHEFFIELD.

(From our own Correspondent.)

Trade Conditions Dull.

THERE is no improvement to record in the trade position of Sheffield, taken as a whole, and as regards both volume of work and turnover the present year, so far, compares unfavourably with 1929. Somewhat better reports come to hand with regard to certain departments, including steel forgings and castings, but other lines have declined farther. The production of open-hearth steel is on a rather larger scale, one or two more furnaces having been put into commission, but the total number employed is only about half of those in the district, and the output is quite equal to the demand, if not in excess of it. Consumers of general lines of steel manufacture appear to have allowed their stocks to reach the minimum level, but they are not showing any willingness to place forward business. A return of confidence in the future would mean a considerable improvement in buying. In the meantime, although orders are numerous, the great bulk of them are of such small dimensions as to be scarcely profitable, and manufacturers cannot see more than a few weeks ahead. A better story comes from North Lincolnshire, where the steel trade continues to occupy a good position, and has not been affected by the general depression.

Special Trades.

There is a good demand for most special lines of steel, including cold wrought material and stainless, and the requirements of the electrical industry continue fairly good. The demand from the automobile industry, however, although on a substantial scale, continues to decline, which is attributed to the uncertainty with regard to the McKenna and safeguarding duties. Mr. R. W. Matthews, President of the Chamber of Commerce, referring to this matter at the annual dinner of the Sheffield branch of the Institute of British Foundrymen, said that Sheffield manufacturers who were engaged in the production of castings, pressings, and springs for motor cars, and the special steels used for gears, valves, and other parts, were being very seriously handicapped as a result of this uncertainty, and a considerable volume of unemployment was also being directly caused by it. He appealed to the Government to "put them out of their misery," by letting them know whether the duties were to come off or stay on. The trade in best quality tool steels, while not good as a whole, has known worse times. There is a substantial sale in the home market, and several leading makers continue to receive orders from foreign countries. In files, saws, and tools, business is uneven and for the most part poor.

Rolling Stock Orders.

The Metropolitan-Cammell Carriage, Wagon and Finance Company, in which Sheffield is largely interested, continues to book useful orders for railway wagons. The L.N.E.R. has placed contracts with that company, and with Head, Wrightson and Co., of Thornaby-on-Tees, for 100 40-ton bogie plate wagons. The Metropolitan-Cammell Company has also received an order for twenty-five 50-ton wagons. The latter are primarily intended for the conveyance of bricks, but are equally suitable for iron-stone slag and other heavy traffics.

Cutlery and Plate.

There is no improvement to record in the cutlery and plate branches. A fair sale is maintained for best cutlery, but this only applies to a small portion of the city's productive capacity. The demand for cheap cutlery has shown a falling off since the big rush which characterised the Christmas season trade. London and the provinces are taking increased quantities of scissors, but the export trade shows a falling off. The demand for safety razor blades compares unfavourably with that of a year ago. Fairly satisfactory order books are reported by makers of hacksaws. The Board of Trade returns for January show that cutlery exports amounted to a value of only £66,339, as compared with £99,555 in January last year and £72,332 in December. Safety razors and blades showed the largest decline, owing, in part, to lessened exports of blanks to America. The value of scissors, at £2783, was little more than half that of the previous January. The only overseas market which showed an increase on previous returns was New Zealand. The import figures were also down, and were, in fact, the lowest for a long period. The total for the month was £22,759, as against £29,379 in December and £88,335 in January last year. There has been a falling off in the importation of American safety razor blades for re-export.

Sheffield's Trade Name.

The Sheffield Advisory Committee continues to perform valuable work in protecting the trade name of Sheffield against wrongful use. The annual report, recently issued, shows that a company advertising cutlery in a trade journal as "Best English cutlery, Sheffield," although the cutlery was not entitled to be so described, discontinued the advertisement and ceased to offer for sale any cutlery so marked. A case was investigated in which a London trader who had no place of business in Sheffield was advertising and selling safety razor blades with the name of the trader and the word "Sheffield," in contravention of the Merchandise Marks Act, 1887. A satisfactory undertaking was obtained from the trader. It was discovered that some traders in France were using the words "Sheffield fashion" in connection with some edge tools, and as a result of representations made by the Board of Trade through the Foreign Office, the traders promised to add the words "Fabrication Française" whenever the words "Sheffield fashion" were used.

Derbyshire Pipe Orders.

The pipe industry in Derbyshire is fairly well employed, and the outlook is considered good. Orders recently booked by the Staveley Coal and Iron Company include 8300 30in. pipes for the Giza sewerage, Cairo; 600 tons of 24in. for Glasgow; 435 tons of 3in. for Shanks; and numerous smaller quantities. The Stanton Iron Company is also doing well in this department.

Sheffield's Advantages.

In its Master Cutler—Mr. A. K. Wilson, governing director of Spear and Jackson, Ltd.—Sheffield has a good publicity agent, who is doing all he can to spread knowledge of the facilities which the city offers to people who are looking for sites on which to establish new industries. He has dwelt on these facilities in more than one recent speech. He points out that Sheffield is ideally situated for the economical working of a motor transport fleet, being at the centre of the largest industrial area in this country, which can be more economically covered from Sheffield than from any other town in the area. With regard to water, Sheffield is in a better position than any other large manufacturing city in the country. Far-seeing industrial concerns will undoubtedly in the future make this one of the major considerations in selecting a site for a new works. The local rates, which were previously a first consideration with anyone contemplating the establishment of a new industry, have, thanks to the De-rating Act, now become a comparatively unimportant item as compared with the cost of coal, electricity, and gas, the facilities for transport, particularly motor transport, the supply of skilled labour, &c. Mr. Wilson maintains that by the passing of the Derating Act, Sheffield has suddenly become transformed from an undesirable area into one of the most favourable in the whole of the country. Mr. Wilson is also strongly supporting the "Buy British Goods" campaign.

A Fine Works Sports Ground.

The facilities existing in connection with Sheffield works for the recreation of the workers are numerous and varied, and a fine addition is about to be made to them in the new sports ground of Arthur Balfour and Co., of the Capital Steel Works. A site at Whirlow Bridge, a few miles from the centre of the city, has been purchased for about £4000. It is no less than 23 acres in extent, triangular in shape, and ideally situated. All kinds of sports are to be catered for, including hockey, Association football, bowling (crown green), tennis for which there are four hard courts, and golf, for which there is a nine-hole course. The area which is to be levelled for Rugby, hockey and cricket, is approximately 27,000 square yards. The lay-out of the ground will be novel, as no one sport will be interfered with by another sport if all the grounds are occupied at the same time.

Various Schemes.

Grimsby Corporation has in view a large scheme of sewerage for Scarehoe, a district incorporated within the borough two years ago. A Ministry of Health inquiry has been held with regard to an application to borrow £40,050 for the purpose of the scheme, which provides for many years ahead. At Mansfield, an inquiry has been held into the Corporation's scheme for the rebuilding of the gasworks, at an estimated cost of £74,000. There was no opposition. Work is to be begun immediately upon the building of pithead baths at Cadeby. The cost is estimated at £30,000, which will be forthcoming from the area fund. Goole Urban Council is proposing to borrow £5000 for enlarging the carbonising plant at the gasworks, and £1000 for installing a naphthalene washing and gas-drying plant.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Trade Outlook.

THE course of the iron and steel trade in the North of England is extremely disappointing. Business shows little or no signs of expansion, and this at a time when there is usually a movement to cover spring requirements. Some descriptions of iron and steel are unsaleable except below cost, and profit on the manufacture of most descriptions of material is well below normal. Aggregate output continues heavy, and firms have still to complete substantial portions of running contracts, but specifications are not being distributed very freely, with the result that plant in certain branches of industry is somewhat irregularly employed. Stocks of pig iron are increasing, but the statistical position is still strong. Doubtlessly makers will, if necessary, curtail output so as to check accumulations. A rise in continental steel prices is expected favourably to influence the position in this district, but no material change can yet be recorded.

Cleveland Pig Iron Trade.

Further relief in production costs has been afforded this week by a fall in coke, but despite the general trade decline ironmasters refuse to make any price concessions. Shipments are very restricted, and home buyers are limiting their purchases to immediate requirements, but it is hoped that buyers will soon be on the market for their spring requirements, and in the meantime prices are unchanged. A little iron from other home-producing districts is still being used in this district, but foreign makes are unable to regain a footing. No. 1 Cleveland foundry iron is 75s.; No. 3 G.M.B., 72s. 6d.; No. 4 foundry, 71s. 6d.; and No. 4 forge, 71s.

Hematite Pig Iron.

Further weakening of East Coast hematite pig iron prices is causing much uneasiness, as market rates have been well below cost for some time past. Merchants are keen to unload their rather substantial holdings, and do not hesitate to cut prices. Producers are fairly well sold over the next few weeks, but are much in need of forward orders. Business is largely confined to sales of moderate parcels to home users. Foreign firms, which usually draw the greater part of their supplies from this market, are buying very little iron here, as they can obtain continental brands at comparatively low rates. Quotations for East Coast hematite vary a good deal, but both makers and second hands offer parcels at the equivalent of ordinary qualities at 78s., and customers claim that they can purchase on lower terms. No. 1 quality is at a premium of 6d. per ton.

Ironmaking Materials.

Quotations for foreign ore are nominal. Consumers are disinclined to take full deliveries against old contracts, and new business is almost at a standstill. Best Rubio is put at 22s. 6d. per ton c.i.f. Tees. Blast-furnace coke is plentiful, and users are not disposed to enter into large commitments, as they expect still lower prices. Good average qualities are 21s. per ton delivered at the works on the North-East Coast.

Manufactured Iron and Steel.

The manufactured iron and steel makers have a fairly large volume of work, but are not booking many new orders. Departments producing shipbuilding requisites and bridge-building material promise to be busy for some time, and branches manufacturing railway construction necessities are not badly off for work. Sheet makers are a little better placed than they have been, but are still in need of orders. Prices are unchanged.

The Coal Trade.

Unless business takes an upward turn in the spring, it is going to be a difficult matter to dispose of the entire output of coal in this district. The coal production is higher to-day than it was at this time last year, and there are many more thousands of tons to sell than there were last February. The market has relapsed into a dull state. There is a considerable amount of second-hand coal about, and a few classes of fuel offered at well below direct quotations do not attract buyers. The colder weather may increase the demand, but there are full supplies of every kind of fuel. Freights are very low, and there is every inducement for quick shipments, but reports are still coming to hand that coal and coke stocks abroad are heavy in many centres and that importers are not anxious for any more at present. Great quantities of coal have been and are being shipped from North-East Coast ports, but whether the volume of loadings can be maintained is problematical, although the spring usually brings an accelerated inquiry from the Baltic and other

northern regions. Best Northumberland steams have a range of about 15s. 3d. to 16s., according to the date of shipment, and there are sellers over the year. Tyne primes are steady at 15s. to 15s. 6d., and seconds are easier at 14s. 6d. Small steams retain their strength better than any class. In the Durham section the coking coal trade has ebbed away, and there is some need for prompt orders. Coking smalls are at from 14s. 3d. to 14s. 6d., and unscreened grades at 14s. 9d. to 15s. Gas coal is moving slowly. Best qualities are quietly steady at 16s. 6d. to 16s. 9d., and second qualities are weak at 14s. 6d. to 15s. Bunkering fuel of the higher brands is rather well bought up, and 17s. continues to be quoted. Good bunkers, however, are obtainable at 16s. and perhaps less, and ordinaries are in ample supply and quieter at 14s. 9d. to 15s. The Durham steams position is moderately good, with large sorts quoted 17s. to 18s., and smalls 14s. to 14s. 6d. Little business is stirring in the coke market. The demand falls short of the available February supplies and values are barely upheld. Quotations are 19s. 6d. to 21s. for ordinary patent foundry coke, 21s. 6d. to 22s. 6d. for gas coke, and 24s. to 28s. for special foundry coke.

SCOTLAND.

(From our own Correspondent.)

Dull Markets.

THROUGHOUT the past week the steel, iron, and coal markets have been dull generally. Practically nothing of fresh interest has occurred, and business on the whole is quiet and without encouragement.

Steel.

Makers of heavy steel have a fair supply of orders for plates and sections, but increased demands would be welcomed. Export inquiries are not particularly bright, however. Speaking generally, plants are far from being fully occupied. Business in sheets is most uneven. Ordinary black sheets are fairly well sold, more especially in the lighter gauges, but galvanised descriptions are in a very depressed condition, with prices about £12 5s. home and £12 per ton export. There is room for considerable improvement in the tube trade so far as the export side is concerned. Makers have not yet derived any benefit from the renewal of the International Cartel agreement covering export prices and quotations.

Iron.

There is no improvement in bar iron and re-rolled steel, and with the works so indifferently employed production can hardly be carried on at a profit. Bar iron prices are nominally unchanged, and the quotation for re-rolled steel remains in the vicinity of £7 12s. 6d. per ton, home or export. The turnover in pig iron still suffers to some extent from imports, and though the output may be steady at recent levels, the total is meagre. Minimum prices are unchanged.

Clyde Engineers: Better Trade Prospects.

In reporting to the National Executive, the Glasgow district secretary of the Amalgamated Engineering Union states that trade is improving, and that unemployment has been considerably reduced. Ship-repairing and locomotive building is better than at this time last year, and it is believed that the improvement in the latter is of a fairly permanent character. Several shipyards have a fair measure of work on hand, and should be able to provide satisfactory employment during the greater part of the year.

Scrap.

The demand for scrap materials has not been particularly brisk of late, and prices, if anything, continue to weaken. Heavy steel is quoted about 67s. 6d.; heavy basic, 62s. 6d.; and cast iron machinery, 69s. per ton.

Pig Iron Imports.

During the past week about 3000 tons of pig iron were unloaded at Glasgow harbour from Calcutta.

Coal.

The depression in the export branch of the trade continues, prompt business being very limited and forward transactions practically nil. The collieries in the Lothians and Fifeshire are affected to a considerable extent. Sidings are becoming congested with loaded wagons, and idle time is increasing. Lanarkshire splints provide an exception to the rule, and are well booked for some time ahead. In all districts washed pearls are in strong request. Aggregate shipments amounted to 259,147 tons, against 245,365 tons in the preceding week, and 153,599 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THERE has been no development in the steam coal trade during the past week to create a brighter or better tone. In fact, the conditions on the whole are rather more disappointing. In some directions collieries are fairly well off for immediate loading, but that is by no means the case generally, and so far as the outlook is concerned there would appear to be some anxiety, inasmuch as business is not displaying the expansion that is desired. Incidentally, South Wales is not alone in feeling quieter conditions. The position is very much the same in all the coalfields, both at home and abroad. In such circumstances, it is only to be expected that competition for available orders is as keen as it can possibly be. Up to the time of writing there was no news regarding the placing of the order for 100,000 tons of steam coals for account of the Brazilian Central Railways, but there is a fresh inquiry on the market for 100,000 tons of small coals for the Portuguese State Railways for Lisbon and Oporto, for delivery over April, May, and June.

Docks and Shipping.

Despite the apparently dull conditions prevailing, shipments last week maintained a very good level. The Great Western Railway's returns came to 613,600 tons, which compared with 644,600 tons for the preceding week. For the corresponding period of last year the total was just over 283,000 tons, but these figures are valueless for comparative purposes, as twelve months ago the country was in the throes of such severe wintry weather that work at the docks was almost brought to a standstill owing to appliances being frozen. At the end of last week there were as many as twenty-three idle tipping appliances at the various docks, with only seven steamers waiting. It will therefore be seen that the loading position was by no means satisfactory. Arrivals over the week-end were, however, fairly good, with the result that on Monday there were thirteen steamers waiting and only five tips were idle, while on Tuesday the position was that twenty steamers were waiting to get into berth and fourteen tips were idle. Of the latter, no less than six were at Cardiff, while it is interesting to note that eleven steamers were waiting to get a tip at Newport. There can be no doubt that the loading position during the next few weeks will display some irregularity. Chartering of late can scarcely be described as active; in fact, it has been on moderate lines and for some directions outward rates of freight have continued to show weakness, with the consequence that very low figures have been recorded, but with the exception of the near trades there is no doubt that there is a better feeling prevailing from the shipowners' point of view. Large-sized tonnage is becoming increasingly scarce owing to steamers being laid up and rates are a shade better for the Mediterranean, though it all depends upon the position of tonnage as to whether they can get actually better rates than those which have been ruling recently.

Tin-plate Trade.

As is well known, the men's representatives have been endeavouring for some time to establish a superannuation scheme for workmen employed in the tin-plate industry, but from all accounts there appears to be little prospect of its early introduction. The matter was referred to at the last annual meeting of the Joint Industrial Council, after which the men's representatives prepared a tentative scheme on the basis of contributions to be made by the employers on a certain average per box and by the workmen of a certain weekly contribution. The retiring age suggested was sixty. It is understood that when the matter was further discussed by a committee, the employers, though feeling that such a scheme was desirable, were not in a position to deal with any definite proposals. The employers' representatives also contended that the burden of such a scheme would in the existing state of the industry impose too great a strain.

Current Business.

The chief trouble of the steam coal industry continues to be the inadequacy of the demand for large coals. Relatively speaking, Monmouthshire qualities are better placed than other descriptions, the tonnage at the disposal of the collieries to lift coals for the Italian State Railways keeping many of them fairly well employed. The inquiry for all other descriptions is on the quiet side, and even dry qualities are not meeting with the inquiry that was in evidence a week or so ago. Sized coals are also very irregular, but small coals maintain a very steady tone on account of the diminution in output. Coke is quiet, but patent fuel makers are comfortably off at the moment. Pitwood rules weak as the result of the very moderate demand, and prices have been on the basis of 25s. to 25s. 3d.

CATALOGUES.

SAMUEL OSBORN AND CO., Ltd., Sheffield.—A folder discussing S.O.B.V. cutting alloy steel.

HATHORN, DAVEY AND CO., Ltd., Dewsbury-road, Leeds. The firm's general catalogue of pumping and hydraulic machinery.

F. J. EDWARDS, Ltd., 406, Euston-road, N.W. 1.—A forty-eight-page stock list of new and reconditioned machine tools in stock.

GEORGE COHEN AND CO., Ltd., 600, Commercial-road East, E. 14.—Catalogue 130 of new and second-hand machine tools in stock.

HEAD, WRIGHTSON AND CO., Ltd., Norton-road, Stockton-on-Tees.—A booklet illustrating the various types of pit-head gears erected by the firm.

TANGENT TOOL ENGINEERING COMPANY, Ltd., Keynsham, near Bristol.—Particulars of Smith's hydraulic units and "Keynsham" motor trucks.

W. RICHARDS AND SONS, Ltd., Britannia Foundry, Middlesbrough.—The tenth annual issue of the firm's chart of iron and steel prices, 1914–30.

DAVEY, PAXMAN AND CO., Ltd., Aldwych House, Aldwych, W.C. 2.—"Users' Opinions of the Paxman Cold-starting 'Spring Injection' Oil Engine."

PARSONS' OIL ENGINE COMPANY, Ltd., Town Quay Works, Southampton.—A descriptive booklet of "M" type engines for land and marine purposes.

ALEXANDER WRIGHT AND CO., Ltd., 1, Westminster Palace-gardens, S.W. 1.—A leaflet on the Simmance "Dead-Beat" pressure indicators and recorders.

BUTLER MACHINE TOOL COMPANY, Ltd., Victoria Ironworks, Halifax.—Catalogue No. 4, containing a detailed description of "Butler" puncher type slotting machines.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., Trafford Park, Manchester.— Publication No. 7977/7, entitled "Electrification Work for Overseas Railways."

"SENTINEL" WAGGON WORKS, Ltd., Iddesleigh House, Caxton-street, S.W. 1.—An eighty-page book dealing in detail with the building, types and uses of the "Sentinel-Cammel" rail cars.

WARREN BROTHERS (MIDDLESBROUGH), Ltd., Prudential Buildings, Middlesbrough.—A booklet describing "Howard's" patented steam separator and a list of ships fitted with the separator.

ATTON AND CO., Ltd., Derby.—A sectionalised loose-leaf book of the firm's products, which include all classes of pipe work and pipe accessories, brackets, tanks, grease separators, relief valves, steam traps, &c.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE RANSOME AND MARLES BEARING COMPANY, of Newark-on-Trent, was awarded a gold medal at the International Exhibition at Barcelona.

MAJOR R. W. JENKINS has been elected chairman of Robert Jenkins and Co., Ltd., of Rotherham, in succession to the late Mr. A. T. Jenkins.

GEORGE ELLISON, Ltd., of Perry Barr, Birmingham, asks us to announce that the address of its London branch has been changed from 25 to 131, Victoria-street, S.W. 1. Telephone: 9830 (3 lines), and new telegraphic address, "Starters Sowest."

NATHAN AND ALLEN, Ltd., ask us to announce that on February 25th they are moving their offices from 25, Victoria-street, to 131, Victoria-street, Westminster, S.W. 1. Their telephone number will remain unchanged, viz., Victoria 9380–1.

CONTRACTS.

THE HUNSLET ENGINE COMPANY, Ltd., of Leeds, has received from the Crown Agents for the Colonies an order for two tender engines, 4–8–0 type, with outside cylinders, 17in. by 22in., for the Ceylon railways.

WORTHINGTON-SIMPSON, Ltd., of Queen's House, Kingsway, London, W.C. 2, and Newark, has received an order to supply Diesel propelling machinery of 240 B.H.P. for a 130ft. salvage vessel to be built by George Brown and Co., of Greenock, for Canadian owners.

THE CENTRAL ELECTRICITY BOARD has placed orders amounting in value to approximately £150,000 for 132 kV transformers in the area of the Mid-East England Electricity Scheme, with the following firms:—Ferranti, Ltd., Hollinwood, Lancs.; the Fuller Electrical and Manufacturing Company, Ltd., 5, Chancery-lane, London, W.C. 2, and the General Electric Company, Ltd., Witton, Birmingham.

ROYAL AGRICULTURAL SOCIETY.—The annual Show of the Royal Agricultural Society of England will, this year, be held at Manchester from Tuesday, July 8th, to Saturday, July 12th, inclusive. The total value of the prizes offered—inclusive of Champion Prizes, Special Prizes, Challenge Cups, and Medals—is £15,690, of which £1503 will be contributed by the Manchester Local Committee, £3434 by various Breed Societies, while £2213 will come from other sources.

COUNTY TECHNICAL COLLEGE AND SCHOOL OF ART, NEWARK.—On Monday last prizes were presented in the Town Hall to the successful students in the County Technical College, and amongst the recipients were fifteen youths who had secured National Certificates of the Institution of Mechanical Engineers. The College has done admirable work, and it was interesting to hear from Dr. W. A. Richardson that the total number of students is now 800, a very remarkable figure in a population of no more than 20,000. There are classes, not only in art and technology, but in commerce and agriculture. Dr. Richardson has been in Newark barely four years, but he has now been elected to a similar appointment at Derby, and his place is being taken by Dr. J. W. Whittaker, of University College, Nottingham.

MANCHESTER ASSOCIATION OF ENGINEERS.—The annual dinner of the Manchester Association of Engineers was held on Friday, February 14th, at the Midland Hotel, Manchester. In the unavoidable absence of the President, Mr. James Robertson, the chair was occupied by Mr. W. G. Gass, ex-President. The toast, "The City and Trade of Manchester" was proposed by Mr. P. M. Oliver, who, in referring to the present depression, said that once Manchester had trade supremacy, but now there was world competition and engineers must face the changes and adapt themselves to them. He believed that sooner or later Manchester's industry would be secure. What was needed was encouragement. The response to the toast was made by the Lord Mayor of Manchester, Councillor R. Noton Barclay, who said that bad as the times were, they were not so bad as in 1830. We were better equipped now than at that time, and the cotton trade had survived remarkably in the face of the great changes in recent years. Trade was suffering in most of the cotton-producing countries, owing to the output being greater than the world's requirements. He believed that the cotton trade was still capable of great developments. It was no use preaching "defeatism," but better to meet difficulties with a smile and a whistle. Mr. Douglas Miller, high master of the Manchester Grammar School, proposed the toast of "The Manchester Association of Engineers," and the toast was acknowledged by the Chairman. The toast "Our Guests" was proposed by Dr. Daniel Adamson, and in his reply Mr. B. Mouat Jones, D.S.O., Principal of the Manchester College of Technology, referred to the extension of the College which was about to be made. As a result of a visit which he had made to similar institutions on the Continent, he had come to the conclusion that we in this country were a long way behind in the matter of higher technical education.

THE MANUFACTURE OF STAYBRITE STEEL.—At the weekly meeting of the Junior Institution of Engineers held on February 14th, there was exhibited a film showing the casting, rolling and machining of Staybrite steel, and the fabrication of articles made of the material as carried out at the Sheffield works of Thos. Firth and Sons, Ltd. Prior to the exhibition of the film, Mr. J. Hopcraft (member) gave some information as to the properties of the metal, stating that its chromium content was 18 to 20 per cent., nickel 8 to 10 per cent., and carbon below 0·2 per cent. It was an Austenitic steel, which could not be hardened or tempered, and when worked cold a tensile strength up to 90 tons per square inch could be obtained. The above specification produced a steel which would be found most generally useful and easily worked. The coefficient of expansion under heat was 50 per cent. greater than that of mild steel, and that had to be allowed for both in patterns used for cast Staybrite and in finished parts, such as pump spindles, piston-rods, &c. It was important that the stresses set up by bending, machining, riveting, &c., should be removed by reheating, and that the scale formed in the latter process be removed by pickling in a nitro-hydrochloric bath, the loosened scale being thoroughly washed off with brushes and water. Mr. Cyril Hall, of the Brown-Firth Research Laboratories, spoke on the welding of Staybrite steel, which could be performed by the oxy-acetylene process, by electric arc welding, and by resistance welding. Electric welding of the steel could be carried out almost in the same way as on mild steel, with electrodes having cores of the same material; the arc should be as short as possible, and the minimum current used. Seam welding by the electrical resistance method was easily effected, but it should be remembered that the thermal conductivity of Staybrite steel was less than that of mild steel, and heat applied to it was not dissipated so easily.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	19/6 to 21/–
(1) Spanish	21/6 to 23/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 1 0	—
No. 1 Foundry	4 0 6	—
No. 3 Foundry	3 18 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 18 0	3 18 0
No. 1	3 18 6	3 18 6
Cleveland—		
No. 1	3 15 0	3 15 0
Silicious Iron	3 15 0	3 15 0
No. 3 G.M.B.	3 12 6	3 12 6
No. 4 Foundry	3 11 6	3 11 6
No. 4 Forge	3 11 0	3 11 0
Mottled	3 10 6	3 10 6
White	3 10 6	3 10 6
MIDLANDS—		
(3) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 15 6	—
„ „ Foundry	3 19 6	—
(3) Northampton—		
Foundry No. 3	3 15 0	—
Forge	3 11 0	—
(1) Derbyshire—		
No. 3 Foundry	3 18 6	—
Forge	3 14 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 13 6	—
No. 4 Forge	3 9 6	—
Basic	—	—
(4) N.W. COAST— N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 9 6 (*a*) / 4 11 6 (*b*) / 4 15 0 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 15 0	—
Second Quality Bars	9 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 2 6 to 9 7 6	—
Gas Tube Strip	11 2 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ¼in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	9 0 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	12 5 0	12 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 10 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	8 5 0 to 8 7 6	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	10 0 0	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	6 10 0	—
Hoops	9 15 0 to 10 5 0	—
Soft Wire Rods	8 0 0	—
MIDLANDS—		
Small Rolled Bars	8 0 0 to 8 15 0	—
Billets and Sheet Bars	6 2 6 to 6 12 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	11 10 0 to 11 15 0	—
Angles	8 7 6	—
Joists	8 10 0	—
Tees	9 7 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 12 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/3 to 18/9
Block Tin (Cash)	173 10 0
„ (three months)	176 10 0
Copper (cash)	70 5 0
„ (three months)	68 0 0
Spanish Lead (cash)	21 12 6
„ „ (three months)	21 10 0
Spelter (cash)	19 5 0
„ (three months)	19 15 0
MANCHESTER—	
Copper, Best Selected Ingots	78 15 0
„ Electrolytic	84 7 6
„ Strong Sheets	110 0 0
„ Tubes (Basis Price), lb.	0 1 3
Brass Tubes (Basis Price), lb.	0 1 1
„ Condenser, lb.	0 1 3
Lead, English	22 17 6
„ Foreign	21 5 0
Spelter	19 15 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

Tungsten Metal Powder	3/4½ per lb.	
Ferro Tungsten	3/1½ per lb.	
	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 7 6	7/6
„ „ 6 p.c. to 8 p.c.	£22 10 0	7/–
„ „ 8 p.c. to 10 p.c.	£22 0 0	7/–
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£30 7 6	10/–
„ „ „ 1 p.c. carbon	£38 0 0	15/–
„ „ „ 0·70 p.c. carbon	£41 0 0	15/–
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/– per unit	
„ „ 75 p.c.	£19 0 0 scale 7/– per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS

SCOTLAND.

(*Prices not stable.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/–
„ „ Ell	16/–
„ „ Splint	16/9 to 18/–
„ „ Trebles	14/–
„ „ Doubles	13/–
„ „ Singles	13/–
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/–
„ „ Jewel	17/6
„ „ Trebles	14/–
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	12/6 to 14/6
Screened Navigation	18/– to 19/6
Trebles	14/–
Doubles	13/–
Singles	13/–
LOTHIANS—	
(f.o.b. Leith)—Best Steam	14/–
Secondary Steam	13/6
Trebles	13/6
Doubles	12/9
Singles	13/–

ENGLAND.

(8) N.W. COAST—	
Steams	21/6 to 23/–
Household	38/– to 51/–
Coke	25/6
NORTHUMBERLAND—	
Best Steams	15/6 to 16/–
Second Steams	14/6
Steam Smalls	11/–
Unscreened	13/– to 13/6
Household	25/– to 37/–
DURHAM—	
Best Gas	16/6 to 16/9
Second	15/–
Household	25/– to 37/–
Foundry Coke	25/– to 30/–
SHEFFIELD—	Inland.
Best Hand-picked Branch	26/6 to 28/– —
Derbyshire Best Bright House	21/– to 23/– —
Best House Coal	20/6 to 21/6 —
Screened House Coal	18/6 to 20/– —
„ „ Nuts	16/6 to 18/– —
Yorkshire Hards	15/6 to 17/– —
Derbyshire Hards	15/6 to 17/– —
Rough Slacks	9/– to 10/– —
Nutty Slacks	7/6 to 8/6 —
Smalls	3/– to 5/– —
Blast-furnace Coke (Inland)	17/– on rail at ovens
Furnace and Foundry Coke (Export), f.o.b.	20/– to 22/–

CARDIFF— (9) SOUTH WALES.

Steam Coals:	
Best Smokeless Large	20/– to 20/3
Second Smokeless Large	18/9 to 20/–
Best Dry Large	19/– to 19/6
Ordinary Dry Large	18/6 to 18/9
Best Black Vein Large	18/6 to 18/9
Western Valley Large	18/3 to 18/6
Best Eastern Valley Large	18/– to 18/3
Ordinary Eastern Valley Large	17/9 to 18/–
Best Steam Smalls	14/9 to 15/–
Ordinary Smalls	13/6 to 14/6
Washed Nuts	19/6 to 28/–
No. 3 Rhondda Large	21/– to 21/6
„ „ Smalls	15/6 to 16/–
No. 2 „ Large	17/– to 17/3
„ „ Through	16/– to 16/6
„ „ Smalls	15/– to 15/6
Foundry Coke (Export)	32/6 to 37/–
Furnace Coke (Export)	27/– to 28/–
Patent Fuel	22/– to 22/6
Pitwood (ex ship)	25/– to 25/3
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	36/– to 38/–
Seconds	29/– to 32/–
Red Vein	24/6 to 29/–
Machine-made Cobbles	42/6 to 45/–
Nuts	45/– to 46/–
Beans	25/– to 27/6
Peas	20/– to 20/6
Breaker Duff	10/9 to 11/3
Rubbly Culm	12/– to 12/6
Steam Coals:	
Large	20/– to 21/–
Seconds	18/6 to 19/6
Smalls	13/6 to 15/–
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 12/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 10/– if home consumers confine purchases from associated British Steel Makers.

French Engineering Notes.

(From our Correspondent in Paris.)

A Training Ship and a New Destroyer.

FOLLOWING closely upon the wreck of the "Edgard-Quinet," which was being used as a training ship, the new "Jeanne d'Arc" has been launched from the Penhoët shipyard at Saint-Nazaire to replace the cruiser of that name that was formerly employed for training purposes and was withdrawn in 1928. The "Jeanne d'Arc" has a displacement of 6600 tons and a length between perpendiculars of 160 m., with an overall length of 170 m. She will be propelled by two geared turbines with four oil-fired steam generators. The turbines will develop 36,000 horse-power, the speed will be 25 knots, and the radius of action 5000 miles. The armament will consist of eight 155 mm. guns, carried in twin turrets, fore and aft. The lighter armament will include four anti-aircraft 75 mm. guns, and there will be two torpedo tubes. Two seaplanes will also be carried. This vessel, which is of real fighting value, is the first that has been specially built for training purposes, and its design presents special features in the way of accommodation, facilities for recreation and spacious lecture rooms. Much prominence is given to the value of the new vessels being built as a means of maintaining national status abroad and promoting trade, and, amongst the French, arguments like those override any question of economy. Another feature of the past week was the breaking of the speed record by the destroyer "Bison," of the "Jaguar" 2700 tons class, which was launched at Lorient. It is declared that in its official trials the "Bison" attained a speed of 41·2 knots, the previous record of 40·188 knots having been made by the "Verdun."

State Railways.

Probably on no French railway system has so much work been done to improve tracks and accelerate traffic during the past year as on the State lines, particularly those for the Transatlantic service between Cherbourg and Paris, and between the Metropolis, Havre and Dieppe. In order to provide for higher speeds 254 miles of track were relaid in 1929, and next year the whole of the line between Paris and Havre will have been entirely reconstructed. Rapid progress is being made with the renewal of rolling stock, which already comprises fifty special coaches for Transatlantic passengers, while 300 metallic vehicles have been built for the Paris suburban lines. The State railways have acquired ten locomotives of the "Mountain" type and a number of "Decapod" locomotives for heavy goods trains. A great deal has also been done to insure safety at level crossings, which exist in large numbers in this country, and many systems of automatic barriers and distance signals are employed.

Rolling Stock.

Now that very little rolling stock is available from Germany for reparations, there is a prospect of locomotive and wagon builders being supplied with ample work for some time to come. Until a few months ago they had, for two or three years previously, done so little that many builders could hardly keep going on repairing coaches, and there was a complaint that, through lack of employment, the industry would suffer permanently from a loss of skilled hands. Since the railway companies were obliged to obtain their rolling stock at home, so many orders have been given out that builders experience difficulty in delivering, and they insist that the companies should distribute their orders regularly, the result being that the Conseil Supérieur des Chemins de Fer has arranged with the companies to prepare programmes of purchases for periods of five years. The new programme, which is awaiting sanction, provides for an increase in the number of locomotives, coaches and trucks to be ordered during the present year. The requirements include 315 locomotives, 580 coaches and 15,425 trucks, but as the companies did not distribute all their orders last year it is expected that these figures will be considerably increased. The situation of wagon builders has been greatly improved by the creation of the international union, which insures for them a monopoly of their own market as well as a percentage of the foreign trade.

Oil Storage.

Important works are being carried out at Rouen, Havre and Cherbourg for the storage of oil, and at Cherbourg a pipe line is to be laid between the Homet wharf and tanks to be constructed at a considerable distance from the port. The tanks will have a capacity of 9000 cubic metres. There will be six pumping stations, and the cost is estimated at 30 million francs. This is only part of a programme of oil storage which is intended to keep in reserve sufficient supplies to meet any energency.

Land Reclamation.

There exist vast areas of marsh land between the Loire and the Gironde, and much of it is utilised as the result of the enterprise of private associations. The State railways are helping forward the work with a more ambitious scheme, which aims not only at drainage, but also the construction of dikes along the sea shore, and it is proposed to reclaim a considerable area of sea between the coast and the islands of Ré, Oléron and Noirmoutier, where the sea is so shallow that at low water the land is mostly uncovered. It is believed that this work is quite feasible by building dikes between the islands and the mainland. The State railways sent to Holland some time ago a commission, consisting of members of the Syndicat des Marais de l'Ouest and experts, in order to examine the reclamation undertakings being carried out in that country. It returned with the conviction that there are no serious difficulties in the way of utilising many thousands of acres of marsh lands and of connecting the islands with the mainland whereby an appreciable addition will be made to the country's agricultural territory. All the railway companies offer every encouragement to local industries and carry out a propaganda for their development as a means of increasing traffic.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

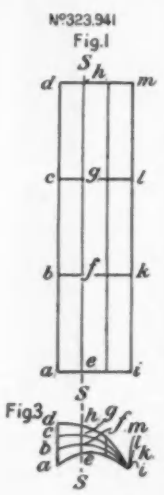
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TURBINE MACHINERY.

323,941. January 26th, 1929.—BLADING FOR STEAM TURBINES, P. Leistritz, Markgrafenstrasse 29, Nürnberg, Germany, and F. Burghauser, Bulmannstrasse 36, Nürnberg.

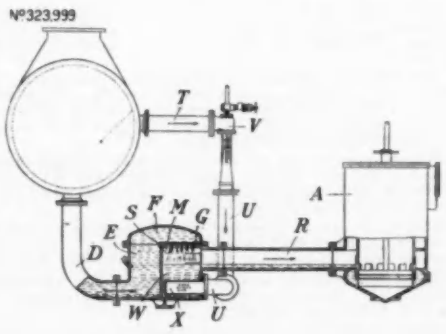
This invention consists in one or both of the blade surfaces being given the form of a warped, non-developable regular plane, or a plurality of such planes, the generating lines of which are straight and lie in planes perpendicular to the rotor axis and the ends of which lie on arbitrarily chosen curves. The application of such regular planes as the limiting surfaces for turbine blades allows of the tip and root sections being selected so as to be entirely independent of each other. Figs. 1 and 3 of the accompanying drawing show in elevation and plan the shape of such a regular plane, which may be regarded as the face or back surface of a stationary or moving blade. Let *a e i* be, for instance, the arbitrarily chosen root curvature of the face surface of a moving blade, and *d h m* the corresponding tip curvature. Any section S—S parallel with the plane of the rotor disc shows the generating line *e h*—Figs. 1 and 3. For any parallel section, as, for instance, S—S, and for any cross-section, as, for instance, *b f k*, showing in the plan view the inter-mediate curvature *b f k*, we have the following relation: *e f* : *e h* (in Fig. 3) = *e f* : *e h* (in Fig. 1). In Fig. 1 the outlet edge *i m* of the blade is shown as being radial. Any other generating line may, of course, be shown as being radial.—*January 16th*, 1930.



CONDENSERS AND FEED-WATER HEATERS.

323,999. June 12th, 1929.—CONDENSING PLANT FOR STEAMSHIPS, G. and J. Weir, Holm Foundry, Cathcart, Glasgow, and J. Sim.

Many steamships already provided with propelling machinery comprising reciprocating multiple-expansion engines and air pumps of the Edwards type are, say the inventors, having their efficiency improved by being provided with exhaust steam turbines arranged to receive the steam discharged from the low-pressure cylinder. In order to benefit by this turbine adjunct, it is usually necessary to improve the condensing arrangements. The condenser is, therefore, enlarged, or re-arranged or replaced, and improvements introduced with regard to abstracting the air from it. The present invention is not concerned with improvements in the condenser, but it is concerned with improvements for abstracting the air therefrom. It is usually desired to retain the Edwards air pump, and, to enable that to be done, a "vacuum-augmenter" is introduced which withdraws the air from the condenser and delivers it into the discharge pipe from the bottom of the condenser to the bottom of the air pump. With this arrangement the engine is started without the turbine, and then, at some convenient time—it may be after the ship has left the harbour and got into its stride—the vacuum-augmenter, and thereafter the turbine, is switched in. (A flexible clutch may be employed for this purpose.) Now, trouble is experienced by the air pump losing its

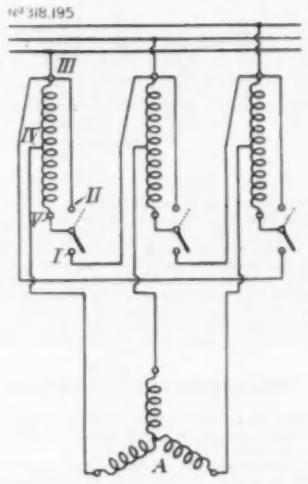


water and becoming dry and thus failing to perform its required duty. That occurs after the vacuum-augmenter has been started. The trouble is thought to be due to the pressure of discharge from the vacuum-augmenter which forces the water back along the delivery pipe from the air pump to the condenser. The object of the present invention is to overcome this trouble, and it is applied to an arrangement of condensing plant comprising a condenser, a reciprocating air pump, and an ejector vacuum-augmenter, which discharges the air from the condenser and delivers it into the discharge pipe from the bottom of the condenser to the air pump. The invention is characterised by the provision of a sealing chamber on this discharge pipe, this sealing chamber containing air in its upper portion and water in its lower portion, that is, there is a well of water at the bottom of the chamber, and by the fact that the discharge from the vacuum-augmenter is delivered into the water in this well and below the surface of the water, and that the condensate from the condenser is delivered into the top of the sealing chamber so as to fall freely and loosely into the well at the bottom. In the drawing reproduced above A is the air pump, V the vacuum-augmenter, and S the sealing chamber. The condensate flows from the condenser through the pipe D and the passage E into the distribution chamber F situated above the sealing chamber. The top of the sealing chamber separating it from the distribution chamber, consists of a perforated plate G. W is the well at the bottom of the sealing chamber. The vacuum-augmenter withdraws the air with vapour from the condenser by way of the pipe T, and discharges it through the pipe U into the perforated pipe X which is submerged in the water in the well W. The air rises through this water into the air space M in the upper portion of the sealing chamber. The condensate falls through the holes in the perforated plate G and enters the sealing chamber in the form of spray, falling through the air space M on to the surface of the water in the well. The steam from the vacuum-augmenter is largely condensed in passing through the water in the well and by the spray, and the air is cooled and much reduced in volume. Both water and air pass from the sealing chamber to the air pump by way of the pipe R.—*January 16th*, 1930.

DYNAMOS AND MOTORS.

318,195. April 23rd, 1929.—THE STARTING OF POLYPHASE ELECTRIC MOTORS BY MEANS OF AUTO-TRANSFORMERS, Ateliers de Constructions Electriques de Charleroi, of 91, rue de l'Enseignement, Brussels, Belgium.

According to this invention the auto-transformer, which performs the usual function of protective inductance or choke coil at the moment of changing over from the reduced voltage to the full voltage when starting an induction motor, presents the further feature of acting as a protective inductance or choke coil for the motor during normal running. The asynchronous motor A is invariably fed from the tapping point IV

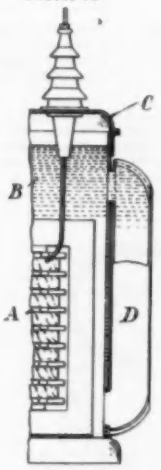


situated about the centre of the phase-winding III—V of the auto-transformer. The change-over switch has two positions—position I is that utilised for starting the motor. Upon changing over from the position I to position II, the portion III—IV of the primary winding performs the function of protective inductance or choke coil during the change over. Lastly, in the position II, the switch short-circuits the entire winding of each phase, the motor remaining connected to the terminal IV. This operation is, therefore, sufficient to ensure the auto-transformer serving as protective choke coil in normal running.—*January 16th*, 1930.

TRANSFORMERS AND CONVERTERS.

306,146. February 15th, 1929.—HEAT DISSIPATING DEVICES FOR IMMERSED ELECTRICAL APPARATUS, *The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C.* 2.

The transformer A is immersed in a body of insulating and cooling liquid B within a casing C. A heat dissipating tube D has lateral openings at its upper and lower ends which communicate with the interior of the casing C. Any desired number of such tubes may be connected to the casing, to give the desired area of heat dissipating surface. Heat appearing in the transformer is absorbed by the liquid B which rises by convection, passes into the upper ends of the tubes D, descends through these tubes where the heat is dissipated to the surrounding air, and finally returns into the lower part of the casing ready to absorb more heat and repeat the cycle. The tube D may be formed from a simple open-ended length of tubing, but in many cases a flattened tube will be desirable, as it has the advantage of a large heat dissipating surface for the quantity and weight of liquid which it contains. When flattened tubes are used, it is also usually desirable to arrange them with their longer diameters normal to the wall of the apparatus casing so that both sides of each tube may be best exposed to the air and so that the maximum number of tubes may be placed side by side in the space available around the apparatus casing.—*January 9th*, 1930.

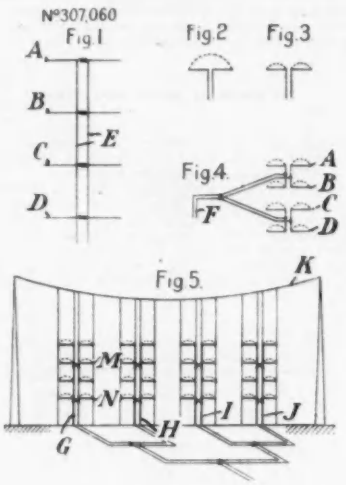


TELEGRAPHS AND TELEPHONES.

307,060. February 13th, 1929.—AERIAL SYSTEMS, Telefunken Gesellschaft für drahtlose Telegraphie m.b.H., of 12-13, Hallesches Ufer, Berlin.

This invention relates to aerial systems and more particularly to aerial systems for use on short waves. Referring to Fig. 1 four separate linear aerials A, B, C, D are arranged above one another and are preferably excited from a common energy conductor E. In Figs. 2 and 3, two special cases for the excitation of the horizontal aerials such as those shown in Fig. 1 are diagrammatically illustrated. In the one case—Fig. 2—an aerial is excited in its half wave length from a current coupling in the middle, while in the other—Fig. 3—it is excited through a potential coupling—not shown—so that the two parts are excited each in a half wave of the same phase. Fig. 4 shows two

systems of horizontal aerials A, B and C, D, which are excited through energy conductors F from a branched feeder system as shown. The excitation of the horizontal aerial may be effected in any convenient manner and the dimensions of the aerials may be so chosen with respect to the wave length that they oscillate in any desired multiple of a half wave length. If the desired direction of radiation is not horizontal, but at a definite angle of inclination with respect to the earth's surface the separate horizontal aerials which are arranged above one another should

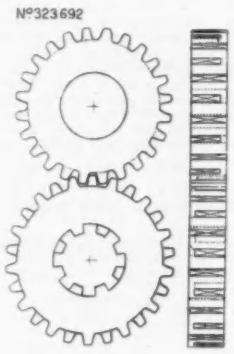


not be in one plane but in parallel planes. If desired, several aerial systems may be arranged in juxtaposition to one another, as is illustrated in Fig. 5, in which four systems are arranged in one plane and are energised through branched conductors G, H, I, J. The horizontal aerials of each system are suspended from a carrier cable K. The separating distances between the horizontal aerials of each system in the arrangement illustrated in Fig. 5 amount in each case to half a wave length, and in order that the excitation may be in the same phase the leads to the aerials M and N are crossed over.—*January 9th*, 1930.

TRANSMISSION OF POWER.

323,692. April 2nd, 1929.—CHANGE SPEED GEARING, S. Ross, 3, Kirkbank, and F. W. McKerrow, James' Park, Burntisland, Scotland.

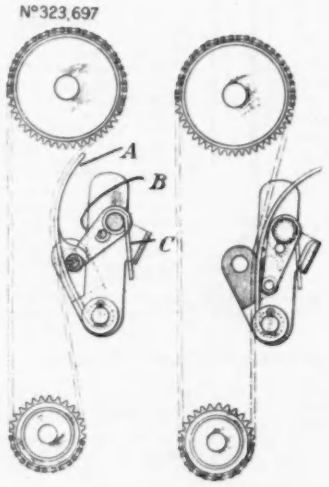
In order to facilitate the meshing of the gear wheels of the normal type of motor car gear-box, when changing gear, the



inventors cut away the ends of the alternate teeth of the wheels, so that every other tooth projects, axially, beyond the next. As a consequence, there is three times the usual amount of space for the immediate entry of the teeth on engagement.—*January 9th*, 1930.

323,697. April 13th, 1929.—MEANS FOR TENSIONING DRIVING CHAINS, Charles H. Pugh, Ltd., and E. W. Starkey, Whitworth Works, Tilton-road, Small Heath, Birmingham.

Instead of using a pulley for taking up the slack in a sprocket chain, the inventors employ a curved plate, or lever, A. This

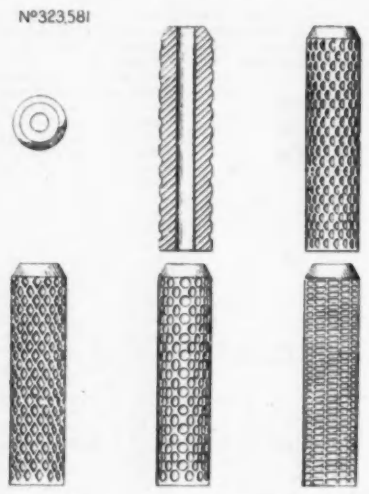


lever is pressed against the outer face of the chain, and, as shown in the two views, takes up the slack as the chain stretches. The principal claim is for the arrangement of the lever B, and spring C, in such a manner that the pressure on the curved lever A progressively increases as the slack in the chain develops.—*January 9th*, 1930.

MISCELLANEOUS.

323,581. October 18th, 1928.—IMPROVEMENTS RELATING TO WALL PLUGS, J. J. Rawlings and the Rawlplug Company, Ltd., Rawlplug House, Cromwell-road, South Kensington, London, S.W. 7.

This invention relates to wall plugs of the kind intended to be inserted in holes previously formed in brick, stone, plaster, marble, or like material, in order to retain a nail or screw or like fastening in such hole, these wall plugs being made, for example, of metal, or of fibrous material held together by a binding agent, or by weaving or plaiting the fibres or strands of the fibrous material. Heretofore, it has been proposed to provide such wall plugs, more especially wall plugs of sheet metal; with exteriorly projecting asperities, the intention being that these asperities shall form keys for holding the wall plug in engagement with the walls of the hole in which it is inserted.



According to this invention, instead of providing outwardly projecting asperities, the wall plugs, made either of sheet metal or of fibrous material held together by a binding agent, have their outer surfaces indented or recessed so that the material in which is formed the hole into which the plug is inserted, can enter into these indentations or recesses and secure the wall plug against rotational or axial movement therein. The keying of the wall plug to the wall of the hole is thus effected by what are in effect projections from the wall of the hole entering the recesses in the exterior wall of the plug instead of, as in the usual arrangement, the projections of the exterior wall of the plug indenting or scoring the wall of the hole. A plug thus indented can be conveniently produced by extruding a pasty or plastic fibrous material through suitable dies, or the indentations can be formed in any desired pattern by passing the extruded material between forming rollers.—*January 9th*, 1930.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

DIESEL ENGINE USERS ASSOCIATION.—Caxton Hall, Caxton-street, S.W. 1. "The Report of the Committee on Heavy Oil Engine Working Costs, 1928–29." 3.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Prince's Chambers, 16, Corporation-street, Birmingham. A visit to the British Industries Fair, Birmingham.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN STUDENTS' SECTION.—Armstrong College, Newcastle-upon-Tyne. "Electrons and Engineers," Mr. B. A. Robinson. 7.15 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London. Annual general meeting. The annual report of the Council will be presented. Annual election of Council. Report to be discussed, Sixth Report of the Steam Nozzles Research Committee. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Ordinary meeting. "The Application of Electric Welding to the Erection and Strengthening of Steel Structures," by Mr. E. P. S. Gardner. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon Tyne. "Powdered Coal for Ship Propulsion," by Admiral W. Scott Hill. 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, W. 1. Discourse, "Principles of Plant Breeding," by Mr. J. B. S. Haldane. 9 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Royal Technical College, George-street, Glasgow.—"Present Views on the Structure and Reactivity of Coke," Mr. F. S. Sinnatt; fourth reel of cinema film, "From Ore to Finished Product." 7.30 p.m.

SATURDAY, FEBRUARY 22ND.

INSTITUTION OF CIVIL ENGINEERS.—Students' Visit to the Deptford West Power Station.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.—Newcastle-upon-Tyne. General meeting. 2.30 p.m.

MONDAY, FEBRUARY 24TH.

KING'S COLLEGE ENGINEERING SOCIETY. — Engineering Society's Room, King's College, London, W.C. 2. "Railway Permanent Way," by Mr. B. E. Willett. 5.15 p.m.

NORTHAMPTON ENGINEERING COLLEGE ENGINEERING SOCIETY.—St. John-street, E.C. 1. Walmsey Memorial Lecture: "Aviation," Mr. C. R. Fairey. 4.15 p.m.

TUESDAY, FEBRUARY 25TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: WESTERN GRADUATES.—Works Canteen, Bristol Tramways and Carriage Company, Ltd., Brislington. "Supercharging," by Mr. P. White. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, S.W. 1. Papers to be submitted for discussion:—"The Development of Lyttelton Harbour, New Zealand," by Mr. C. J. R. Williams; "Tyne Commission Quay, North Shields," by Mr. R. F. Hindmarsh; "Cochin Harbour Works," by Mr. R. C. Bristow. 6 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. Tees-side Branch Graduate Section. "Some Large Span Modern Bridges and Their Erection," Mr. J. Walton. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, W. 1. "X-ray Determination of the Structure of Cellulose," Sir William Bragg. 5.15 p.m.

WEDNESDAY, FEBRUARY 26TH.

ENGINEERING GOLFING SOCIETY.—At the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Annual general meeting. 12.30 p.m.

FARADAY HOUSE OLD STUDENTS' ASSOCIATION AND FARADAY HOUSE RUGBY CLUB.—Supper dance at the Hotel Russell, Russell-square, W.C. 1, from 8 to 2.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—Engineers' Club, Albert-square, Manchester. "The Double-Six Engine," by Mr. L. H. Pomeroy. 7 p.m.

INSTITUTION OF CHEMICAL ENGINEERS.—At Burlington House, Piccadilly, London, W. 1. "The Formation and Growth of Crystals," by Professor W. E. Gibbs. 8 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Visit to the works of Barrow, Hepburn and Gale, Ltd. 2.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. Graduate Section. Paper by Mr. L. C. Burrill. 7.15 p.m.

THURSDAY, FEBRUARY 27TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Chamber of Commerce, New-street, Birmingham. "Creep of Metals at High Temperatures," by Mr. R. W. Bailey. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS AND ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Joint meeting. "Latest Developments of Aero Engines," Mr. A. J. Rowledge. 7.45 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: LUTON GRADUATES.—Royal Hotel, Mill-street, Luton. "Rationalisation," by Mr. M. C. Pash. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, W.C. 2. Faraday Lecture on "Broadcasting by Electric Waves," Captain P. P. Eckersley. 5.30 p.m. The Hon. Sir Charles A. Parsons, O.M., K.C.B., F.R.S., will present to the Institution an oil painting of Sir Joseph Wilson Swan, executed by Mr. W. Paget.

INSTITUTION OF PRODUCTION ENGINEERS.—Blackfriars House, Parsonage, Manchester. Initial meeting of the new Manchester Section. "Work and Scope of the Institution," by Mr. R. H. Hutchinson. 7.30 p.m.

INSTITUTION OF WELDING ENGINEERS.—Caxton Hall, Westminster, S.W. 1. "The Training of Operators in the Welding and Cutting Industries," Mr. J. Ryder. 7.45 p.m.

KING'S COLLEGE ENGINEERING SOCIETY. — Engineering Society's Room, King's College, London, W.C. 2. "Modern Practice in the Manufacture of Portland Cement," by Mr. B. C. Mathiesen. 5.15 p.m.

LEEDS ASSOCIATION OF ENGINEERS.—Griffin Hotel, Leeds. "Industrial Lighting," by Mr. L. Tye. 8 p.m.

FRIDAY, FEBRUARY 28TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: DERBY GRADUATES.—King's Café, St. Peter's-street, Derby. Annual dinner. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. "The Design of Electrical Machinery," by Mr. J. Rowcroft. 7.30 p.m.

SATURDAY, MARCH 1ST.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Queen's Hotel, Keighley. Annual dinner. 5.45 p.m.

MONDAY, MARCH 3RD.

BIRKBECK COLLEGE.—Breams-buildings, Fetter-lane, E.C. 4. "An Isometric Diagram of the Construction of the Dome of St. Paul's Cathedral," by Professor Beresford Pite. 5.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—Hotel Metropole, Leeds. Annual dinner. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London, S.W. 1. Graduates' Section, London. Annual meeting. Informal discussion on "Workshop Practice at Home and Abroad." 7 p.m.

TUESDAY, MARCH 4TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Society of Arts, John-street, Adelphi, W.C. 2. General meeting. "Combustion in Diesel Engines," Mr. H. R. Ricardo. 7.45 p.m.

WEDNESDAY, MARCH 5TH.

INSTITUTION OF CHEMICAL ENGINEERS.—Geological Society, Burlington House, Piccadilly, W. 1. "The Formation and Growth of Crystals," Professor W. E. Gibbs. 8 p.m.

FRIDAY, MARCH 7TH.

INSTITUTE OF MARINE ENGINEERS.—Connaught Rooms, Great Queen-street, London, W.C. Annual dinner. 7 for 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London, S.W. 1. Extra general meeting. "The Strength and Design of Fusion Welds for Unfired Pressure Vessels," by Mr. L. W. Schuster. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Ordinary meeting. "Chile and Engineering in Chile," by C. J. Hartley, M. Inst. C.E. To be read by P. C. Dewhurst, M.I. Mech. E. 7.30 p.m.

SATURDAY, MARCH 29TH.

FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION.—Troeadero Restaurant, London. Annual dinner.

INSTITUTION OF ELECTRICAL ENGINEERS.—At the Ordinary Meeting of the Institution of Electrical Engineers to be held at 6 p.m. on Thursday, February 27th, the Hon. Sir Charles A. Parsons, O.M., K.C.B., F.R.S., will present to the Institution an oil painting of Sir Joseph Wilson Swan. The portrait is by Mr. W. Paget.

BRITISH INDUSTRIES FAIR

SOME BRITISH OIL ENGINES EXHIBITED AT BIRMINGHAM

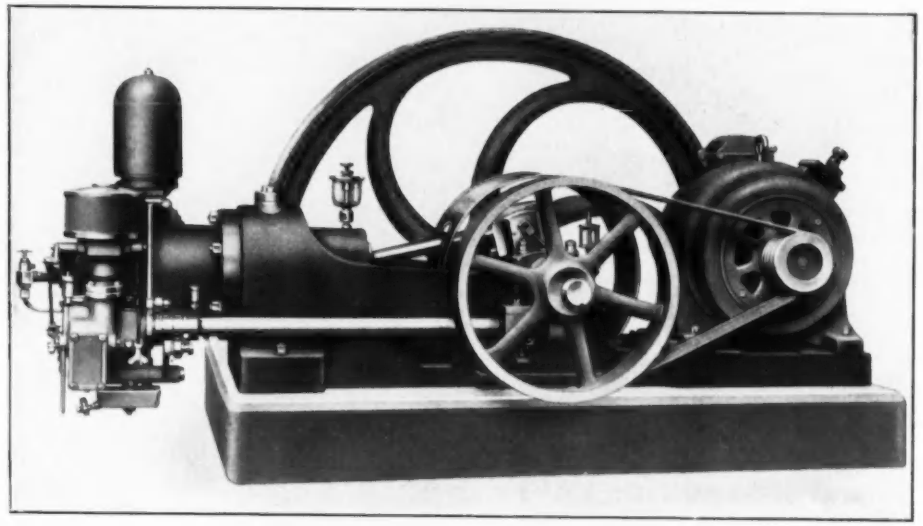


FIG. I.—11 B.H.P. OIL ENGINE—NATIONAL

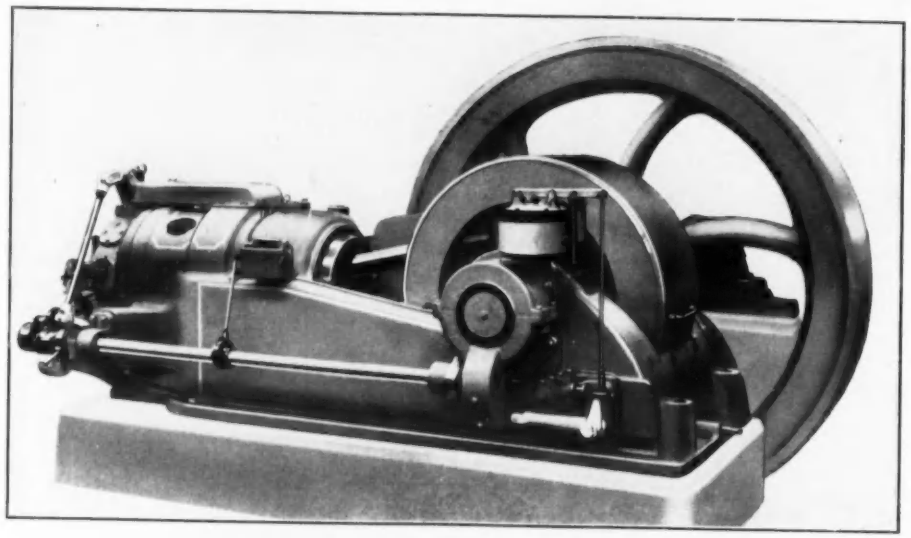


FIG. II.—150 B.H.P. OIL ENGINE—BLACKSTONE

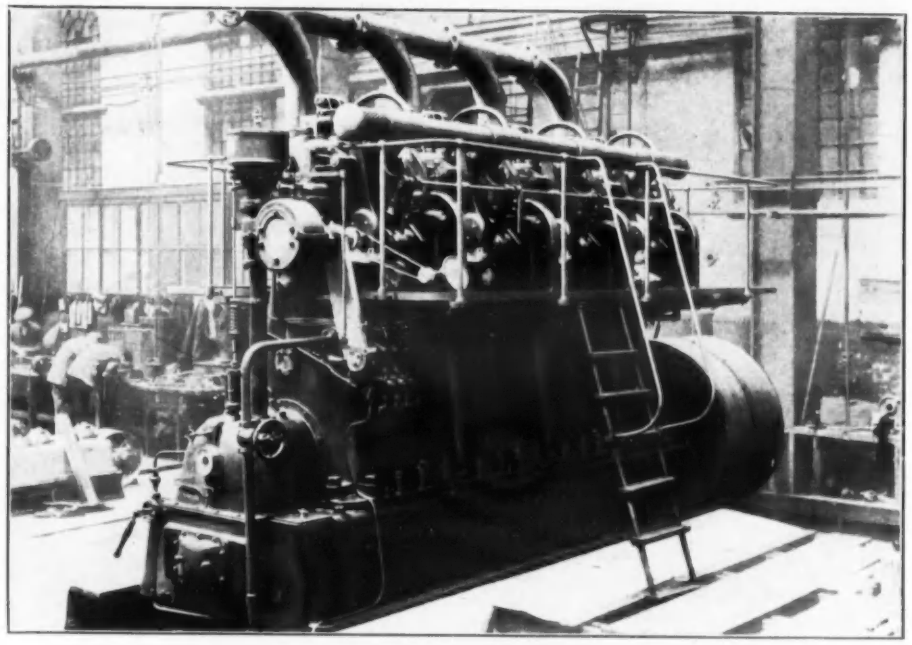


FIG. III.—265 B.H.P. OIL ENGINE—DAVEY, PAXMAN

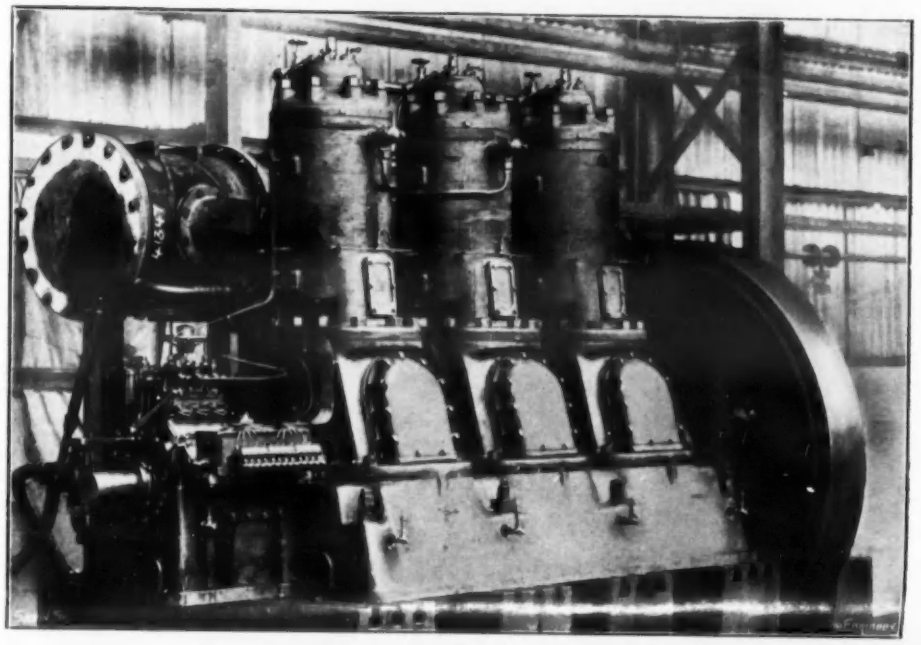


FIG. IV.—195 B.H.P. "ATOMIC" OIL ENGINE—PETTERS

FIG. III.—265 B.H.P. OIL ENGINE DAVEY, PAXMAN

FIG. IV. 195 B.H.P. "ATOMIC" OIL ENGINE PETTERS

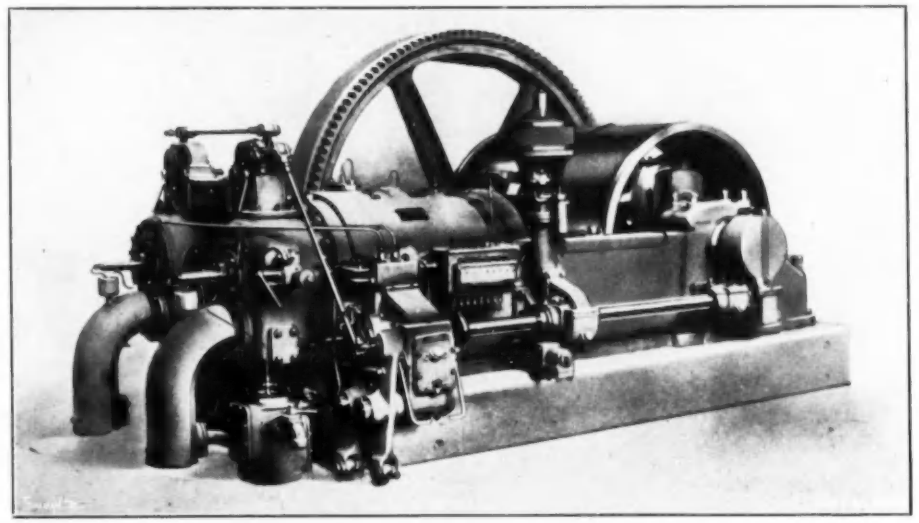


FIG. V.—144 B.H.P. TWIN OIL ENGINE TANGYES

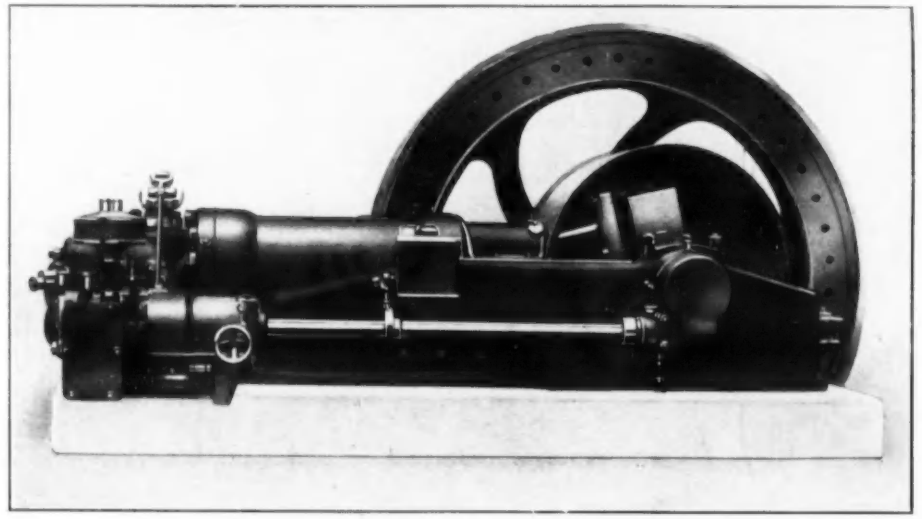


FIG. VI. 55 B.H.P. LOW-PRESSURE OIL ENGINE FIELDING AND PLATT

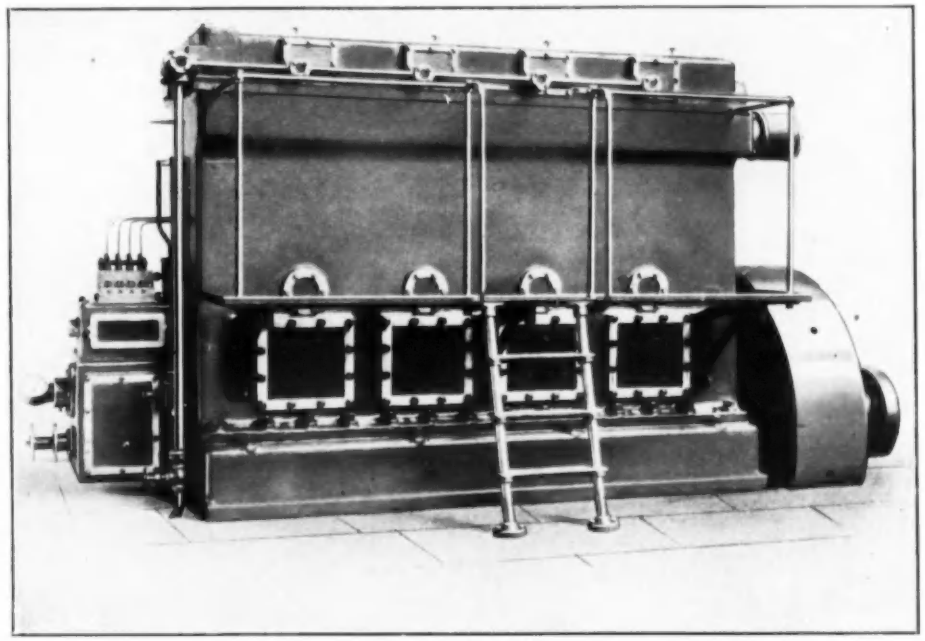


FIG. VII.—220 B.H.P. COMPRESSORLESS OIL ENGINE—CROSSLEY

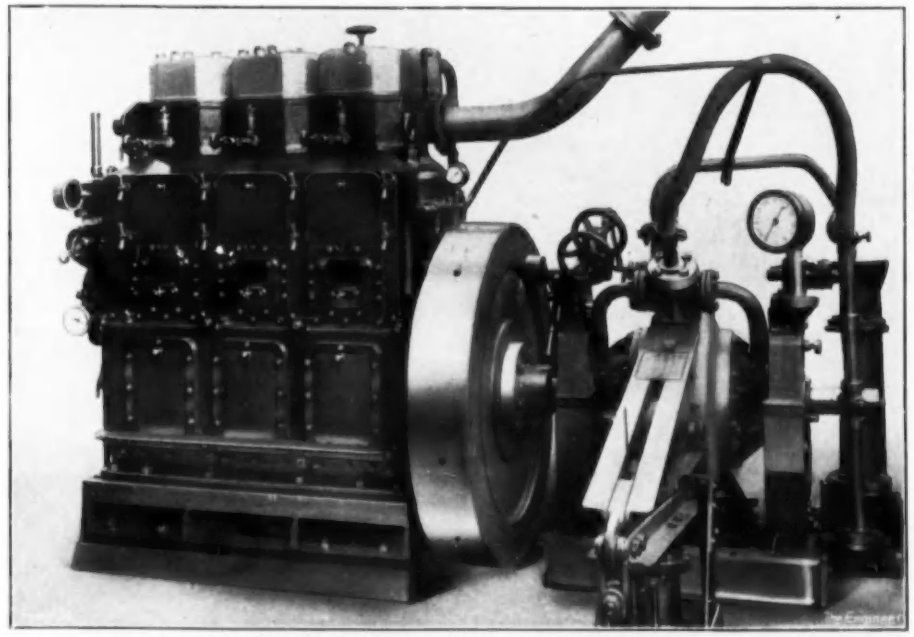


FIG. VIII.—100 H.P. AIRLESS-INJECTION OIL ENGINE—ALLEN

UNIV. OF MICH.